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The surgical anatomy of the principal regions of the human body. Pt. 1.

Col. plates

THE

SURGICAL ANATOMY

OF THE

PERINÆUM.

BY

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ILLUSTRATED WITH LITHOGRAPHIC PLATES, AND WOOD ENGRAVINGS.

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ADVERTISEMENT.

The object of this work is to present the Student engaged in anatomical pursuits with a systematic plan, by which he may proceed in his dissections of the Perinæum; and, at the same time, to induce him to connect the knowledge which he thus obtains of the anatomy of this region, with the study of the diseases occurring within its limits, and the surgical operations which may be required for their relief. It is hoped, also, that the work may prove useful to those who, having quitted the schools, may still be desirous to keep up or renew their acquaintance with the anatomy of this important division of the human body.

The lithographic plates, which serve to illustrate the work, have been engraved with great accuracy, after original drawings, carefully made from my own dissections. Of the wood engravings, the first is executed after a drawing made from the parts dissected; the second is copied from one of the plates in Sir Charles Bell's work on Operative Surgery; and the third is taken from an engraving in Scarpa's memoir on the cutting gorget of Hawkins. I wish, also, to take this opportunity of acknowledging the assistance which I have derived, in the completion of this work, from a perusal of the valuable treatise on Surgical Anatomy, by M. Velpeau, the distinguished surgeon of the Hospital of La Charité at Paris.

Thomas Morton.

University College,
1st Oct. 1838.

THE SURGICAL ANATOMY

OF

THE PERINÆAL REGION.

CHAPTER I.

DISSECTION OF THE PERINÆUM.

WHERE it is in the power of the dissector to select a subject, he will find it of considerable advantage to make choice of the body of a muscular adult who has died of some lingering disease; more particularly so when it is his intention to study with exactness the numerous and important vessels and fasciæ which are situated within the boundaries of this region. It is by no means an easy task to make even a tolerably satisfactory display of these structures when the subject is much loaded with fat.

Previously to fixing the subject in the position which is best suited for the dissection of the perinæum, it is strongly recommended that the introduction of the catheter both in the curved and straight forms should be practised, and the several modes of effecting its introduction compared with one another; and also the most likely means of avoiding the natural obstacles which the many irregularities of the internal surface of the urethra and the structures that surround the canal are capable of presenting to the easy passage of the instrument. When the subject has been tied up in the usual position, with the thighs widely separated, it is frequently extremely difficult to introduce a catheter or staff without using a considerable degree of force, and running a great risk of lacerating the lining membrane of the urethra, and thus making a false passage; accidents

which ought to be avoided, as they will interfere with the perfect display of the parts in the dissection which is about to be made.

After the catheter has been introduced into the bladder, it should be allowed to remain there, while an examination of the prostate gland and the neck of the bladder is made from the rectum by means of the forefinger of the left hand introduced by the anus into that intestine. It will be found, as soon as the extremity of the finger has entered a little way within the anus, that the calibre of the rectum becomes suddenly very much enlarged; and this more particularly so in elderly subjects, and in those who have suffered in their lifetime from habitual constipation. When the palmar surface of the finger is directed against the anterior or upper wall of the bowel, that part of the catheter which rests in the membranous portion of the urethra will be readily distinguished, since the thickness of the structures that intervene between the finger and the catheter is very inconsiderable; at the same time, it will be readily conceived that the coats of the rectum are in very great danger of being cut in the lateral operation of lithotomy, unless the edge of the knife is carefully directed downwards and outwards, at the time when the membranous portion of the urethra is opened, previously to passing the knife along the groove of the staff into the bladder.

Introducing the finger a little farther into the rectum, still keeping it applied against the anterior surface of the intestine, the prostate gland will be perceived by its greater thickness, and by the sense of resistance which its firm and dense structure offers to the finger when it is compressed between it and the catheter. By carrying the finger a little to the side of the mesial line, a much larger proportion of the prostate gland may be felt, which is owing to the greater size of its lateral lobes.

Beyond the base of the prostate gland the catheter is again felt more distinctly through the thin coats of the base of the bladder; this is the spot that is selected by the surgeon for entering the trocar when he punctures the bladder from the rectum for the relief of cases of complete retention of urine, and in which the prostate gland is not much enlarged.

In persons who are far advanced in years, the prostate gland

is not unfrequently found to be much increased in size, and also to be almost surrounded, so to speak, by the rectum ; as the bowel, instead of lying simply underneath the gland, rises very considerably upon each side of it, and in such a manner as to invest it for two-thirds, and sometimes even more, of its circumference : this is a circumstance that is worthy of being borne in mind during the performance of the lateral operation of lithotomy upon aged individuals.

It is by examining the prostate gland in this manner, with his finger introduced into the rectum, that the surgeon is enabled to determine whether it is diseased or not ; and he is enabled by the same means to direct the point of the catheter with greater certainty in cases where the introduction of it has been rendered more than usually difficult by any injury or disease of the membranous and prostatic portions of the urethra. With the fingers introduced into the rectum, it is possible sometimes to determine the weight and figure of a calculus more accurately than by any other means, and to facilitate the seizing of the stone by the forceps after the operation of lithotomy has been performed in cases where the calculus lies deeply behind the prostate gland in the bas-fond of the bladder. It is from the close connections that exist between the rectum and the membranous and prostatic portions of the urethra that the recto-vesical operation of lithotomy derives its simplicity and easy execution ; though for other reasons, that will be noticed in another part of this work, it is an operation which has not been very favourably entertained by the profession.

Position of the subject.—When these preliminary steps have been taken, the catheter may be removed, and a full-sized staff introduced into the bladder ; after which, the subject is to be fixed in the usual position as when the operation of lithotomy is about to be performed, which is done by bending the legs and thighs upon the trunk, and then tying the hands and feet together with bandages. The penis and scrotum are next to be tied up to the handle of the staff, in such a manner as that they shall not obscure the view of the perinæum : the buttocks of the subject ought to be made to project a little beyond the edge of the table upon which it lies ; and, if it should be considered to be necessary, they may be elevated a little

more by placing a block of wood underneath the sacrum. The rectum is to be moderately distended with a little cotton wool introduced into the anus. Before commencing the incisions of the skin, which are necessary for the exposure of the subjacent structures, it will be found of great use to refer for a moment to a dried preparation of the bones and ligaments of the pelvis, in order to determine more accurately upon the recent subject the osseous boundaries of the perinæal region. As continual reference will be made in the course of the dissection to the bones of the pelvis, the dried preparation should be placed upon the table so as to be near at hand.

Extent of the perinæal region.—Anatomists have differed much from each other in their description of the extent and boundaries of the perinæum, and the greater number perhaps have restricted the application of the term to the space which is included between the posterior fold of the scrotum and the anus. More lately, however, it has become the custom to include the anal region also; and then the boundaries of the perinæum will extend from the arch of the pubis, which is in front, to the tip of the coccyx and the great sacro-sciatic ligaments behind; the branches of the ischia and ossa pubis, and the tuberosities of the former bones, will form its limits laterally.

In the recent subject the inferior edge of the large gluteal muscles may be added, as forming a part of the postero-lateral boundary. In this manner of viewing it, the perinæal region will present an ovoid figure, the largest extremity of which is directed backwards, and the narrow or elongated one anteriorly. If a line is drawn transversely between the tuberosities of the ischia, the perinæal region will be divided into two compartments of nearly equal size: that which is posterior to this line will contain the anus, with the inferior portion of the rectum; while that in front of it will comprise the urethra and the root of the penis, together with the numerous structures which are connected with them. The first of these may be termed the *anal*, and the second the *urethral* division of the perinæal region.

The urethral division, or the perinæum strictly so called, may be said to present the form of a triangle, the base of which, represented by the transverse line drawn between the tuberosities of the ischia, is a little less in its extent than the

sides, the length of the sides being from three inches to three inches and a half; while the base scarcely equals three inches, and most frequently is rather less.* The raphé or central line of the body will subdivide this triangular space into two smaller triangles, which are of equal size, within one of which the first incisions of the lateral operation of lithotomy must commence.

The external surface of the perinæum is convex anteriorly from side to side, which is owing to the prominence of the bulb of the urethra; but between the tuberosities of the ischia it is more or less excavated, especially where the anus is situated. The skin is thin and delicate, and easily moveable upon the subjacent structures, which requires that it should be fixed with the fingers of the left hand while the first incisions of lithotomy are being made. Generally the perinæum is more or less covered with hair, which ought to be removed with the razor previously to the performance of any operation upon this region. There are numerous follicles which open upon the surface of the skin, especially around the circumference of the anus; these follicles frequently inflame and suppurate, forming small abscesses, which might be mistaken for a fistula in ano. In front of the anus the raphé or central elevation of the skin is particularly distinct where it extends forwards towards the scrotum. It is upon the left side of the raphé, and about one inch in front of the anus, that the first cut of the lateral operation of lithotomy is usually commenced, which is carried in an oblique direction downwards and outwards between the anus and the tuberosity of the ischium, a little nearer, however, to the latter point than to the anus. The length of this incision is from two to three inches.

In the bilateral operation of lithotomy the external incision commences on the right side, between the tuberosity of the ischium and the anus; and is carried across the perinæum in a semicircular direction, until it is made to terminate opposite to the point at which it was begun. The centre of the incision should be

* In twenty-three subjects which he examined for this purpose, Dupuytren found the base of the urethral portion of the perinæum of very variable extent; in some cases not exceeding two inches, and in others being as much as three inches and a half. Velpeau has seen the tuberosities of the ischia as near to one another as $1\frac{3}{4}$ inch. In my own observations I have seldom found the base to exceed $2\frac{3}{4}$ inches.

situated about three-quarters of an inch in front of the anus, with the anterior half of the circumference of which its concavity should be made to correspond.

The skin around the anus is of a dark brown hue, and at the margins of this opening it becomes insensibly continuous with the mucous membrane of the rectum: when the anus is closed, the skin is thrown into numerous radiated folds or wrinkles, which arrangement no doubt allows the anus to be largely distended without a rupture of the cutaneous tissues. The interspaces between these folds sometimes become the seat of very troublesome ulcerations in some forms of venereal disease, and cause the patient much pain and annoyance. These ulcerations may nevertheless exist independent of any syphilitic taint, and excite by their irritation such a painful and constant contraction of the sphincter muscle, that it becomes necessary to divide its fibres completely across before a cure can be obtained.

Within the margin of the anus the extremities of the hæmorrhoidal veins are usually observed in a varicose state, forming those little tumours which are well known as constituting the affection termed piles. There are two varieties of these tumours; one which consists in the simple varicose dilatation of the veins of the intestine; and the other in which the tumours are in part formed by the veins dilated, and partly by coagula of blood which has become extravasated into the adjacent cellular tissue in consequence of a rupture of the coats of the vessels. The margins of the anus are frequently also the seat of the firm fleshy tumours called condylomata, which consist of a simple hypertrophy of the cellular structure; and though very commonly the consequence of the irritation of gonorrhæal discharges, yet may exist independently of any specific disease.

Dissection of the Perinæum. — The dissection may be commenced by exposing the superficial fascia and external sphincter muscle of the anus. For this purpose make an incision from the scrotum backwards, following the direction of the raphé of the perinæum, as far as the anterior margin of the anus, when the edge of the knife must be carried round that aperture, and thus encircle it, where the skin and the mucous membrane of the rectum are blended with one another; from the posterior margin of the anus a single incision is to be made as

far as to the coccyx, upon which it may terminate. Another incision must be made across from one tuberosity of the ischium to the other, passing in front of the anus; the extremities of this last cut should be extended for some distance upon the thighs. These incisions should not be made deeper than is necessary for the dissection of the skin from the subjacent structures. Laying hold of the inner angles of the flaps which have been thus marked out, raise them for a considerable distance on each side, and then reflect them upon the thighs and buttocks, where they may be fixed by means of pins or hooks. While raising the two posterior flaps, the edge of the scalpel must be carried round the anus in the direction of the fibres of the external sphincter muscle, which, being immediately underneath the skin, is at once exposed to view. The fascia lata of the thighs may be displayed a little distance upon each side by removing the thin layer of adipose tissue which covers its external surface, and conceals its attachments to the external margins of the tuberosities and branches of the ischia and ossa pubis. While this is being done, some small nerves, which pierce the fascia lata a little in front of the lower edges of the great gluteal muscles, will be found; and which, after dividing into several smaller filaments, pass inwards towards the mesial line, supplying the integuments of the perinæal region. These nerves are branches of the posterior and internal cutaneous divisions of the small sciatic nerves. More posteriorly, a part of the inferior border of the large gluteal muscles may be dissected, and their attachment to the lateral borders of the coccygeal bones and posterior sacro-sciatic ligaments shown.

Between the external margin of the sphincter of the anus and the borders of the tuberosities of the ischia, a large quantity of adipose substance will be observed, which must be next removed in order that the fibres of the levator ani muscles may be exposed, as they descend from the sides of the pelvis towards the extremity of the rectum.*

* In removing the masses of fat which fill up on each side the space between the anus and the tuberosities of the ischia, the knife should not be carried farther forwards than a line extended across the perinæum in front of the anus, in order to avoid doing any injury to the superficial fascia where it passes upwards to unite, behind the transverse muscles of the perinæum, with the deep fascia or triangular ligament of the urethra.

During the removal of this fat, some small arteries which run in its substance should be preserved: these are the external or inferior hæmorrhoidal arteries, branches from the internal pudic vessels, and given off from these as they are running along under cover of the tuberosities of the ischia. They are distributed to the superficial structures around the inferior extremity of the alimentary canal. These little vessels are worthy of attention, as they are frequently divided in the operations of lithotomy and of fistulæ in ano, &c. and may sometimes furnish a considerable quantity of blood; sufficient indeed to render the application of a compress or a ligature necessary, to prevent the continuance of the bleeding.

When all the fat has been removed, a large excavated hollow remains on each side of the anus; these have been named by M. Velpeau the *ischio-rectal fossæ*. The figure of each of these spaces is triangular, the base being formed by the skin, and the apex or summit by the angle where the fibres of the levator ani separate from the obturator fascia. The internal wall is very oblique, and is formed by the fibres of the levator ani; the external one on the other hand is nearly perpendicular, and is formed by the obturator fascia and the tuberosity of the ischium.* The depth of the cavity increases towards the external wall, where it may be estimated at nearly two inches. If the subject has been injected, by placing the finger against the external wall of the cavity, about an inch above the edge of the tuberosity of the ischium, the internal pudic artery can be

* The obturator fascia is a thick and strong membrane, which binds down the obturator internus muscle to the internal surface of that part of the os innominatum, and to the ligament of the thyroid foramen, from which its fibres take their origin. The fascia is attached superiorly to the margins of the thyroid foramen, posteriorly to the spinous process of the ischium, and inferiorly to the falciform process of the great sacro-sciatic ligament, and the rami of the ischium and os pubis. Relations—externally with the obturator interuus muscle; internally with the pelvic fascia, part of the origin of the levator ani, and the adipose substance which fills the ischio-rectal space. The internal pudic vessels and nerve, as they pass from the smaller sciatic foramen, by which they re-entered the pelvis, to their termination in the branches which they furnish to the bulb, corpus cavernosum, and dorsum of the penis, are inclosed in a sheath, which is formed by the division of the fascia into two lamellæ at this point. The inferior hæmorrhoidal and superficialis perinæi arteries pierce this fascia immediately after their origin from the trunk.

felt as it is running along enclosed between the layers of the fascia, accompanied by its corresponding veins and nerve.

It is in the large quantity of adipose tissue which occupies the ischio-rectal fossæ, that the greater number of those abscesses form which degenerate into confirmed fistulæ in ano. By a reference to the structure of the walls of the ischio-rectal cavity, it will be readily understood why it happens that these fistulæ can rarely be cured, except by the division of the external sphincter muscle; an operation which allows the walls of the fistula to remain at rest, and to unite with one another by the process of granulation.

The superficial fascia of the perinæum is next to be exposed by removing the layer of adipose and cellular tissue which lies between it and the skin. It is difficult to effect this in corpulent subjects without doing some injury to the fascia, which in such instances is frequently very thin and weak. The best way is to remove the subcutaneous layer carefully by degrees in one spot, until the smooth and regular surface of the fascia is exposed, when it can be followed on each side to its insertions into the edges of the branches of the ischium and ossa pubis, forwards into the scrotum, and posteriorly to its attachment to the triangular ligament of the urethra.

When these directions have been properly executed, the structures which are exposed to view are as follows: surrounding the anus is the external sphincter muscle, in front of which is the superficial fascia of the perinæum; on each side of the sphincter muscle are the ischio-rectal fossæ, emptied of the large masses of adipose tissue which naturally fill them; the inner walls of the fossæ are formed by the fibres of the levator ani muscles, which must be more completely displayed by removing a thin fascia that covers them, and which is a prolongation backwards of the triangular ligament of the urethra: posteriorly are the coccyx, the inferior border of the great gluteal muscles, and, under cover of these, part of the sacro-sciatic ligaments; externally to the tuberosities of the ischia, a portion of the fascia lata of the thigh is exposed. (See Plate I.)

Before proceeding any further with the dissection, each of these structures should be more closely examined in succession.

The *external sphincter of the anus* encircles the inferior extremity and orifice of the rectum. The muscle is of an ellipti-

cal figure, and is composed of two bundles of fleshy fibres, which are united with one another in front and behind the aperture of the anus, at the same time diminishing in their breadth. Posteriorly, the fibres of the muscle are attached to the extremity of the coccyx by means of a narrow fibro-cellular band of about an inch in length; anteriorly, the fibres are inserted partly into the inferior surface of the superficial fascia, and partly into the central tendinous point of the perinæum. The structure of the muscle is fleshy, except at its attachment to the coccyx, where it is slightly tendinous. In some subjects the muscle is very thick and strong, while in others it is extremely delicate. Relations—inferiorly, this muscle is covered by the skin; superiorly, with the superficial fascia and the levator ani, from which last, however, it is separated by some of the fibres of the triangular ligament of the urethra; externally, with the adipose tissue which occupies the ischio-rectal fossæ; and internally,

EXPLANATION OF PLATE I.

This represents a dissection of the superficial fascia of the perinæum: posteriorly, the external sphincter and levatores ani muscles are dissected in order to show the ischio-rectal fossæ.

1. 1. The superficial fascia of the perinæum. This fascia covers the muscles of the penis, and is attached on each side to the edge of the branches of the ischia and ossa pubis; anteriorly, it is continuous with the dartos of the scrotum.
2. 2. These figures indicate the point where the superficial fascia of the perinæum passes behind the transverse muscles to become attached to the anterior surface of the triangular ligament of the urethra.
3. 3. The fascia lata of the thighs covering the adductor muscles.
4. 4. The tuberosities of the ischia.
5. The coccyx.

a. The external sphincter muscle surrounding the anus, which is stuffed with a little cotton wool. The attachment of the fibres of the muscle upon the inferior surface of the superficial fascia is seen in front; posteriorly, the fibres are connected by a fibro-cellular band to the coccyx.

b. *b*. The inferior border of the great gluteal muscles.

c. *c*. The levatores ani. Between the tuberosities of the ischia and the anus, are the hollow spaces named by M. Velpeau the *ischio-rectal fossæ*.

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with the circular muscular fibres of the intestine, which are here more strongly developed than elsewhere, and which in consequence have been named the *sphincter ani internus*. The action of this muscle is to close the extremity of the rectum, and prevent the escape of its contents. It belongs to the class of voluntary muscles, and is supplied by a branch from the pudic nerve.

This muscle is cut across in the recto-vesical operation of lithotomy and in the operation for fistula in ano, and occasionally also to promote the cure of painful and obstinate ulcerations near the margin of the anus.

The *internal sphincter* muscle consists, as has been already mentioned, of the most inferior of the circular fibres of the muscular coat of the rectum, and which are more strongly developed than the rest. Circular in its form, the muscle embraces the mucous membrane of the bowel, and is covered externally by the external sphincter.

The *levator ani* muscle is but partially seen in this stage of the dissection, as only those of its fibres have been exposed which are attached at the circumference of the muscle to the spinous processes of the ischia, and to the tendinous band which stretches across from them to the posterior surface of the bodies of the ossa pubis; which band is situated at the summit of the ischio-rectal fossæ, in the angle that is formed by the separation from one another of the pelvic and obturator fasciæ. The fibres of the muscle are inserted into the sides of the coccyx, and between the extremity of that bone and the anus they are blended with one another by means of a common band of junction, which is situated above the posterior portion of the external sphincter of the anus; more anteriorly the remaining fibres descend to be inserted between the external sphincter and the muscular coat of the rectum; having attachment to both of these structures. The structure of the muscle is chiefly fleshy, though it is slightly tendinous where it is inserted into the coccyx, and the raphé between the extremity of that bone and the anus.*

The *superficial fascia of the perinæum* is situated in the anterior or urethral division of the perinæal region, and is a thin

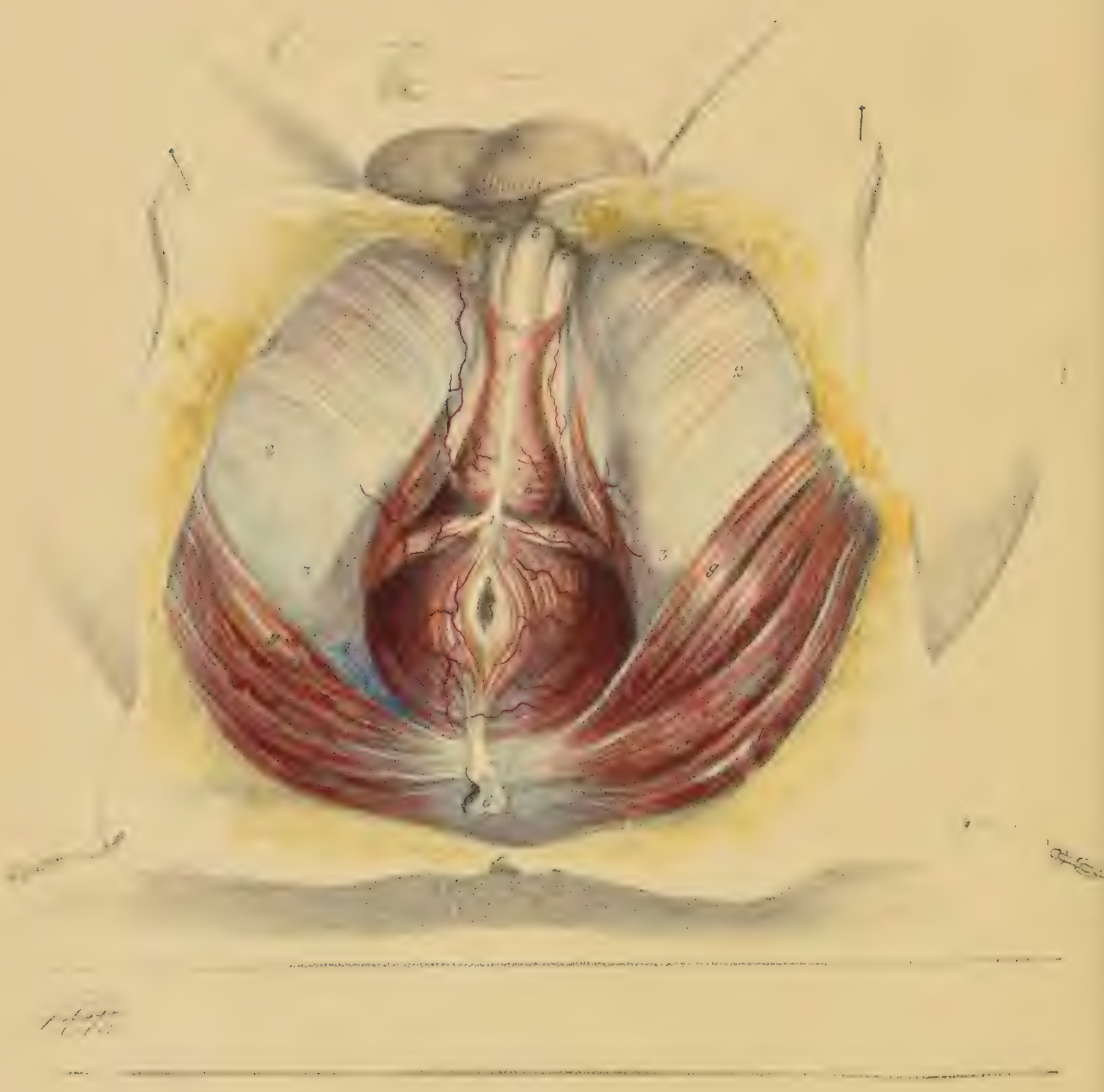
* For a more complete description of this muscle, see page 47.

membranous layer which conceals the muscles of the penis. On each side the fascia is attached to the borders of the branches of the ischia and ossa pubis; anteriorly it passes forwards into the scrotum, where it appears to become continuous with the dartos; posteriorly it is inserted into the inferior surface of the triangular ligament of the urethra, behind the posterior border of the transverse muscles of the perinæum, which it covers. The superficial fascia is pierced at various points by some of the small cutaneous branches of the superficial arteries and nerves of the perinæum. Relations—by its inferior surface with the skin, the subcutaneous layer of adipose tissue, and some of the fibres of the external sphincter muscle which are inserted into it near the mesial line; by its superior surface with the crura and erector muscles of the penis, the accelerator urinæ, and transverse muscles, and with the cellular tissue which fills up the interspaces between them, in which the superficial vessels and nerves of the perinæum ramify.

If a small slit be made into this membrane posteriorly, and the extremity of a blowpipe introduced underneath it, the air which is inflated will be observed, after distending the perinæal portion of the fascia, to pass forwards into the scrotum, and diffuse itself into the loose cellular tissue which separates the dartos from the sheath which the spermatic cords and testicles receive from the margins of the external abdominal rings. If the inflation is continued, the air will, after distending the scrotum, make its way upon the front of the abdomen in the loose cellular tissue which connects the aponeuroses of the external oblique muscles with the superficial fascia of the inguinal and hypogastric regions. It is by following the same course that the urine, which is sometimes extravasated underneath this fascia by a rupture of the anterior part of the urethra, is seen to make its way along the perinæum into the scrotum, and even upon the anterior and lateral parts of the abdominal parietes.*

Dissection of the muscles of the penis.—The muscles of the penis may now be exposed by laying open the superficial fascia by a crucial incision, and reflecting to either side the flaps,

* Previously to the description of the superficial fascia by Mr. Colles, of Dublin, it was found difficult to explain the course which the urine pursued when extravasated into the perinæum, as may be seen by referring to the second volume of Mr. Abernethy's Surgical Observations, p. 245.



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which will show more completely the attachments of the fascia to the edges of the arch of the pubis, and the mode in which it incloses the root of the penis and its muscles, as it were, in a sheath. In dissecting the muscles of the penis it is necessary that the edge of the knife should be carried in the same direction as that of their fibres, for they are very delicate and easily injured. While removing the cellular tissue which fills up the space between the accelerator urinæ and the erectores penis, the small arteries, which are named *superficialis* and *transversus perinæi*, branches of the internal pudic arteries, may be also dissected and preserved :—the first of these runs forwards between the erector penis and the accelerator urinæ, and the other along the posterior border of the transverse muscle. Each of these arteries is accompanied by corresponding branches of the nerve and veins.

A delicate fascia, which closely invests each of the muscles of the penis, must be removed before the direction of their fibres can be clearly seen. (See Plate II.)

The *erector penis* is a long narrow muscle placed beneath

EXPLANATION OF PLATE II.

This represents the muscles of the perinæum. The superficial fascia has been removed.

1. The common central tendinous point of the perinæum.
2. 2. The fascia lata of the thighs.
3. 3. The tuberosities of the ischia.
4. 4. The corpora cavernosa of the penis.
5. The corpus spongiosum urethræ.
6. The coccyx.
7. The great sacro-sciatic ligament.

a. a. The erector muscles of the penis.

b. b. The accelerator urinæ muscle.

c. The raphé or fibro-cellular line from which the fleshy fibres of the accelerator urinæ muscle take their origin.

d. d. The transverse muscles of the perinæum.

e. e. The external sphincter muscle of the anus.

f. f. The levatores ani.

g. g. The great gluteal muscles.

A triangular space is observed between the accelerator urinæ and the erector penis muscles, the base of which is formed by the transverse muscle. The depth of this space is limited by the triangular ligament of the urethra.

the ramus of the ischium and root of the penis. The muscle on each side arises from the inner surface of the tuberosity of the ischium by fleshy and tendinous fibres, and, after passing forwards and upwards about three inches, is inserted into the sides of the corpus cavernosum by two delicate processes, of which the external one is the longest. The muscle is fleshy in its structure, except at its origin and insertions, where it is slightly tendinous. Relations—inferiorly and externally, with the superficial fascia of the perinæum; superiorly, with the ramus of the ischium and the crus of the penis, into which it is inserted; internally, with the accelerator urinæ, from which it is separated by a little cellular tissue and the superficialis perinæi artery. Action—to assist in the erection of the penis.

The *transversus perinæi* is a small triangular-shaped muscle, extending across the middle of the perinæal space. The fibres of this muscle are attached by their broad extremity to the inner surface of the tuberosity of the ischium above the attachment of the erector penis, and they are inserted into the central tendinous point of the perinæum, where they are united with the fibres of the muscle of the opposite side, and with some of those belonging to the accelerator urinæ and the external sphincter of the anus. The muscle is fleshy, except at its insertion, which is tendinous. Relations—by its posterior and inferior surface, with the superficial fascia; and superiorly, with the triangular ligament of the urethra: the superficial artery of the perinæum crosses the muscle near its origin, and, as it does so, gives off the transverse artery which runs along the posterior border of the muscle.

These muscles are sometimes absent altogether, and then their place is frequently supplied by some muscular fibres which run obliquely forwards and join the accelerator urinæ; at other times one of these muscles only is to be found. When these muscles are accompanied by another set of fibres following nearly the same direction, the smaller and most anterior set are called *m. transversalis alter*. Use—to fix the central point of the perinæum, and thus facilitate the action of the sphincter ani and accelerator urinæ.

The muscle of the left side, with its accompanying artery and nerve, is cut across in the lateral operation of lithotomy; in the bilateral operation the muscle of each side is divided.

The *accelerator urinæ* is situated in the centre of the perinæum, and surrounds the bulb and posterior part of the spongy body of the urethra. This muscle is divided into two equal portions by a cellulo-fibrous band or raphé, which extends forwards from the central point of the perinæum as far as the whole length of the muscle, and which has given rise to the usual description of it as consisting of two muscles, though it may equally as well be considered as one. The muscular fibres, after their origin from the central raphé, incline obliquely outwards and forwards, and are inserted, posteriorly, into the anterior surface of the triangular ligament of the urethra near to its attachment to the branches of the ossa pubis; the middle fibres encircle the spongy part of the urethra, and are re-united to each other underneath the junction of the crura of the penis, while those most anterior are prolonged for a considerable distance forwards and outwards to be inserted into the sides of the corpora cavernosa penis, opposite the point where the penis, when in the flaccid state, bends upon itself in front of the pubis. The figure of the muscle is cylindrical in its centre, where it embraces the spongy body of the penis; but anteriorly and posteriorly it presents the form of a simple groove, which supports the bulb and part of the spongy body. The structure of the muscle is fleshy, except at its origin and insertions, where it is slightly tendinous. Relations—inferiorly, with the superficial fascia and skin; superiorly, with the triangular ligament, the bulb and spongy body of the urethra; in the mesial line it is connected posteriorly, through the medium of the common central point, with the external sphincter of the anus and the transverse muscles. Action—to propel forwards the urine and seminal fluid.

There can be no doubt, from the mode in which the middle fibres of this muscle encircle the urethra, that it may by a spasmodic contraction prevent for a time the introduction of a catheter along that part of the canal. The truth of this observation has been frequently proved in practice during the introduction of bougies, &c. Some of the most posterior fibres of this muscle are commonly cut in the lateral operations of lithotomy.

When the muscles have been dissected, a triangular space is exposed between the accelerator urinæ and the erector penis, the

base of which is directed posteriorly, and is formed by the transverse muscle; in this space the superficialis perinæi artery runs forwards in its course to the scrotum. If the finger or the handle of the scalpel be placed in this space, its further progress inwards will be arrested by the triangular ligament of the urethra, which limits its depth: when the muscles are held apart from each other, the triangular ligament may be partially seen; it is of a bluish colour, and of a tendinous structure.

The knife is carried obliquely across the posterior part of this triangular space in the lateral operation of lithotomy. It should however be recollected that, previous to the dissection of the muscles, this space is very much smaller than it now appears.

The *central tendinous point* of the perinæum is that spot where the fibres of the accelerator urinæ, external sphincter of the anus, and transverse muscles are united with one another; it is covered by the skin and superficial fascia, and it rests upon the triangular ligament of the urethra between the bulb and the rectum. The cellulo-fibrous raphé, which has been described as connecting the lateral portions of the accelerator urinæ muscle to each other, extends forwards from this point.

Dissection of the bulb of the urethra, crura of the penis, &c. — The transverse muscles and the erectors of the penis should next be cut away entirely, to expose the crura of the penis, and the greater part of the triangular ligament of the urethra; after which, divide the accelerator urinæ muscle along the mesial line, and carefully reflect the flaps on each side so as to follow the fibres to their respective insertions; by this way they may be traced round the spongy body of the urethra, immediately in front of the bulb.*

* It is sometimes recommended, for this purpose, to cut the urethra across about three inches in front of the bulb, and turn it downwards by dissecting it from the body of the penis. By following this method, it is true that the fibres of the muscle may be very clearly seen to unite with one another in the angle which is formed by the junction of the crura of the penis. But if it is the intention of the dissector to proceed throughout with the dissection, it will be better not to do this, as the continuity of the urethra is interfered with. It is better in such case to be contented with showing the circular fibres by pulling alternately upon each flap of the muscle after their reflection.

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If the accelerator urinæ is now removed altogether, that portion of the spongy body which had been covered by it, with the bulb of the urethra, will be completely exposed to view; on each side, the crura of the penis are seen where they are fixed into the branches of the pubis; the triangular ligament of the urethra occupies the interval between these structures, and, by being prolonged backwards, covers the external surface of the levator ani muscle, separating its fibres from the external sphincter of the anus, and the adipose tissue which filled the ischio-rectal fossæ. (See Plate III.)

The *crura* of the penis are the posterior extremities of the corpora cavernosa, and differ only from them in the greater thickness of the fibrous investment which encloses the vascular or erectile tissue, of which their internal structure is composed. The crura of the penis are at first separated from one another by the width of the arch of the pubis; but as they proceed forwards and upwards they converge towards the mesial line, and opposite the symphysis unite with one another, forming by their junction the larger part of the body of the organ, assuming the name of the *corpora cavernosa penis*. The corpora cavernosa are two cylindrical-shaped bodies, slightly compressed

EXPLANATION OF PLATE III.

This represents the root of the penis and bulb of the urethra, with the triangular ligament of the urethra; the muscles of the perinæum having been cut away.

1. The coccyx.
2. 2. The tuberosities of the ischia.
3. 3. The fascia lata of the thigh.
4. 4. The great sacro-sciatic ligaments.

a. The bulb of the urethra.

b. The corpus spongiosum urethræ.

c. *c*. The crura of the penis.

d. *d*. The corpora cavernosa penis.

e. *e*. The external sphincter muscle of the anus.

f. *f*. The levatores ani covered by a thin fascia, which is a prolongation of the triangular ligament of the urethra.

g. *g*. The great gluteal muscles.

h. *h*. The triangular ligament of the urethra. The artery of the bulb is seen on the left side as it runs between the crus penis and the bulb of the urethra.

however from side to side, which extend forwards as far as the base of the glans penis, which they support upon their rounded extremities. The dorsal vessels and nerves of the penis run in the groove which the corpora cavernosa present superiorly by their junction in the mesial line, while the spongy body of the urethra lies in a similar but deeper groove upon their inferior surface.

The structure of the corpora cavernosa consists externally of a strong fibrous sheath, which is thickest near their posterior extremities, or the crura, as they are termed, of the penis, and internally, of a vascular structure, which has been considered as an intermediate structure between arteries and veins, and named "*erectile tissue.*" The vascular structure of the corpora cavernosa has no communication with that of the corpus spongiosum urethræ.

There is an imperfect septum which separates the cavity of one corpus cavernosum from that of the other, and which from its figure has been called the *septum pectiniforme*, in which are numerous oblong-shaped foramina that allow a free communication to be established between the internal structure of one cavernous body and that of the opposite side. By making a small puncture into one of the cavernous bodies, and introducing some air by means of a blow-pipe, the body of the penis becomes distended as in the state of erection, but none of the air which is thus inflated passes into the corpus spongiosum urethræ.

The corpora cavernosa are suspended to the symphysis pubis by a triangular-shaped band of fibro-cellular or ligamentous structure, which is called the *suspensory ligament* of the penis, and which is inserted by its base into the posterior part of the groove upon their upper surface.

The urethra, where it is supported in the groove on the inferior surface of the corpora cavernosa, is surrounded by a thin layer of erectile tissue, which is named the *corpus spongiosum urethræ.* It differs from the corpora cavernosa in the greater thinness of its external fibrous investment, and in the small quantity of the erectile tissue of which it is composed. At each extremity the corpus spongiosum presents a very considerable enlargement, the anterior of which is the *glans penis*, and the posterior the *bulb of the urethra.*

The *glans penis* is so named from its figure, which, when partially covered by the prepuce, resembles an acorn. It is of a conical figure, its base being seated upon the anterior extremities of the corpora cavernosa; at its apex is a vertical slit or fissure, which corresponds to the external opening of the urethra (*meatus urinarius*). The base of the glans presents a thick rounded and elevated margin (*corona glandis*), which is disposed so obliquely that the superior surface of the glans is three or four times as long as the inferior. Behind the corona glandis is a deep groove from which the mucous membrane which lines the internal surface of the prepuce is reflected upon the surface of the glans; here are numerous sebaceous follicles which are named *glandulæ Tysoni*. The inferior surface of the glans is slightly grooved for the insertion of the small band (*frænum præputii*) which fixes the prepuce to the glans, and prevents its being retracted to too great a degree.

The glandulæ Tysoni are frequently the seat of venereal ulceration, which may affect either one or many of them at one time. The sore is of a circular form, excavated, with sharp edges; when there are several of these affected at one time, it constitutes the form of the disease which has been named Confluent Chancre. When a chancre occurs upon the frænum, it frequently perforates that fold of the mucous membrane, which should then be cut completely across as the first step towards promoting the cure of the sore.

The *bulb of the urethra* is the posterior extremity of the corpus spongiosum, and is so named from its figure. The greater part of the bulb is placed below the canal of the urethra, and lies upon the anterior surface of the triangular ligament, to which it is firmly fixed by a fibrous investment which it receives from the ligament. Its structure consists internally of a large quantity of erectile tissue, which is a continuation of that of the corpus spongiosum. The canal of the urethra presents a slight depression in its inferior surface opposite the bulb, which is often the cause of some difficulty being experienced in the introduction of a catheter or bougie, by entangling the point of the instrument. When the lining membrane of the urethra is torn at this point, a copious hæmorrhage is a common result. The corpora cavernosa and the bulb of the urethra receive large branches from the internal pudic arteries.

The skin of the penis is remarkably thin, and loosely adherent to the subjacent fibrous structures, so that it readily accommodates itself to the varying states of the organ. Anteriorly, the skin of the penis is continuous with the mucous membrane which is reflected from the base of the corona glandis upon its inner surface; the fold which is thus formed is named the *prepuce*, and the extent to which it covers the glans is very different in different individuals: there are some who cannot uncover the glans at all, which condition forms what has been named a *congenital phymosis;* there are others, again, in whom the prepuce is so short that the glans is habitually uncovered, and between these two states innumerable varieties may occur. The *frænum præputii* is the small duplicature of mucous membrane which retains the prepuce in its situation; it is situated on the under surface of the glans.

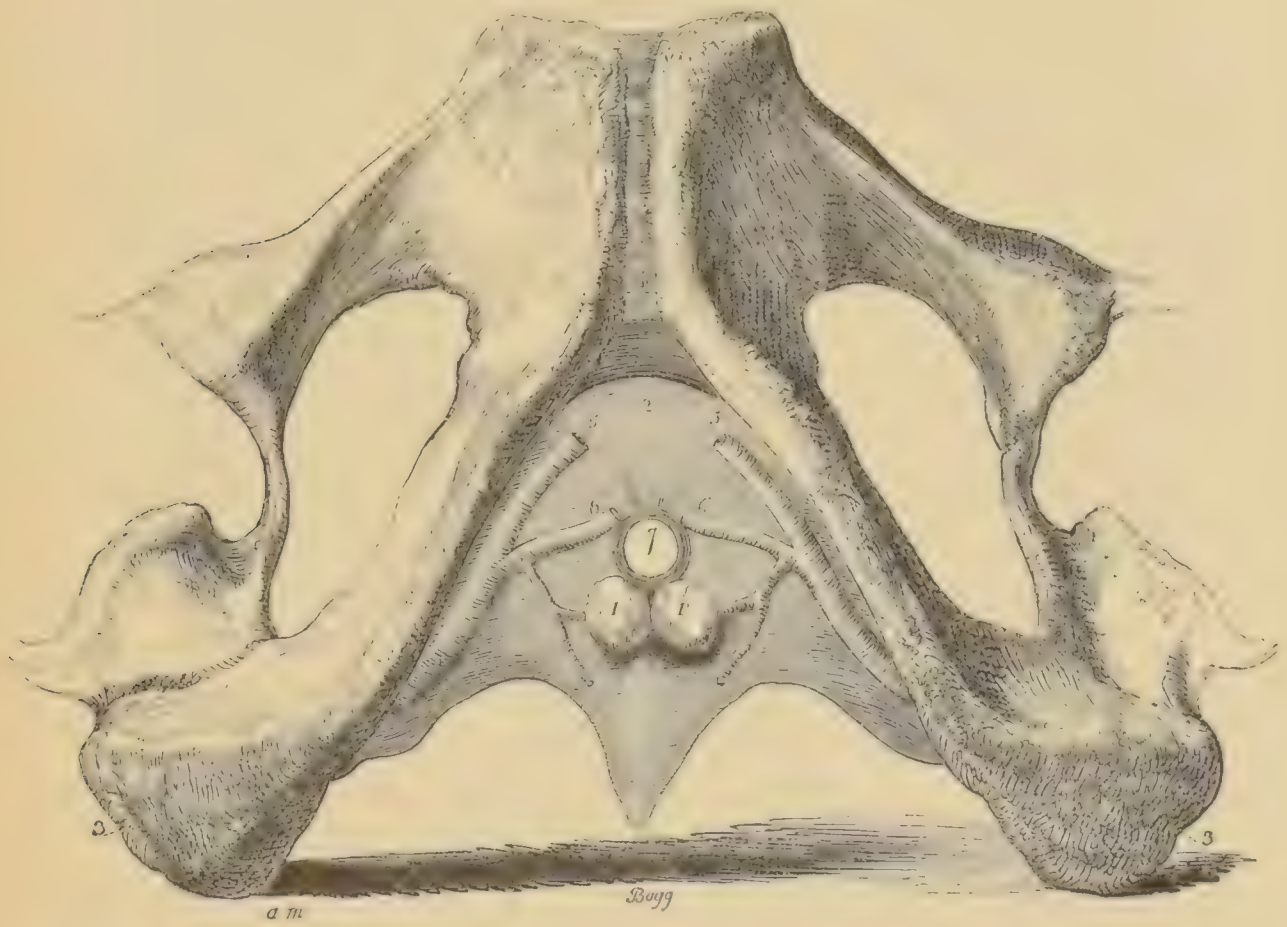
There is a small artery that runs in the substance of the frænum; this little vessel, when it has been divided in the operation for phymosis, should be either ligatured or cauterised, as large quantities of blood have been known to have been lost in consequence of a neglect of these precautions.* The cellular tissue which connects the skin of the prepuce to the mucous membrane is so extensible, that after an operation for phymosis, though every precaution possible may have been previously taken to make the section of the two surfaces of exactly equal extent, the edges of the incision become widely separated by the retraction of the skin. Some surgeons recommend the use of the interrupted suture to bring the edges into contact with one another, while others prefer to cut away the whole of the mucous membrane that may yet remain undivided.

The *triangular ligament of the urethra*, or *deep fascia of the perinæum*, is a strong membranous structure which closes up the anterior part of the inferior outlet of the pelvis. It is attached on each side to the borders of the branches of the ischia and ossa pubis; superiorly, it incloses between its layers the subpubic ligament, and is continuous with the periosteum which lines both surfaces of the symphysis pubis; inferiorly, this fascia has usually been considered as ceasing opposite the lower border of the transverse muscles of the perinæum, though in

* I have known a patient lose as much as three pints of blood after an operation for phymosis, where this vessel had not been secured.

reality it may be traced upon the external surface of the levator ani muscle and the rectum, where, however, it is exceedingly thin and weak. Several openings exist in the triangular ligament, some of which serve for the passage of vessels, and others transmit the rectum and the membranous portion of the urethra.

The opening which allows of the passage of the membranous portion of the urethra is situated nearly one inch below the



The engraving represents the triangular ligament of the urethra where it fills up the arch of the pubis: the penis, and all the soft parts covering the bones, have been removed, as also the anterior lamina of the ligament, for the purpose of showing the situation of the glands of Cowper and the arteries of the bulb. In consequence of the rectum having been removed, the ligament presents the appearance of terminating inferiorly by a free border, which, in the natural condition of the parts, is not the case. The figures 1. 1. mark Cowper's glands. 2. The posterior lamina of the triangular ligament of the urethra. 3. 3. The tuberosities of the ischia. 4. The symphysis pubis. A little below this figure is observed a strong semicircular band of fibres, which is the sub-pubic ligament. 5. 5. The dorsal arteries of the penis, or last branches of the internal pudic arteries. 6. 6. The arteries of the bulb. 7. The foramen or opening in the triangular ligament through which the membranous portion of the urethra passes.

symphysis of the pubis, and is equidistant from the inner edge of the branches of the ossa pubis; this opening is of a circular figure, and about three or four lines in diameter. The membranous portion of the urethra receives, as it passes through, a fibrous investment from the margins of the opening on each side. About half an inch below the symphysis pubis several smaller apertures are formed in the ligament, which serve for the passage of the dorsal arteries, veins, and nerves of the penis.

The triangular ligament of the urethra is composed of two layers of fibro-cellular or tendinous structure, the fibres of which are arranged chiefly in a transverse direction. Between the layers are the sub-pubic ligament superiorly, and lower down Cowper's glands and the arteries of the bulb; besides these structures there is a quantity of tissue, the nature of which has not yet been satisfactorily determined, but which is considered by some anatomists as partaking of a vascular character, while by others it is supposed to be fibrous, if not muscular.

Mr. Guthrie has described two muscles in this situation, which, according to his description, surround the membranous portion of the urethra, and may, by their contraction, be a cause of retention of urine. Their fibres run transversely, and are attached by their extremities, which are elongated, to the rami of the arch of the pubis.*

The direction of the triangular ligament is vertical above, oblique inferiorly, where it covers the levator ani muscle. Relations —by its anterior surface, with the bulb of the urethra, the muscles of the penis, and the external sphincter; posteriorly, with the membranous portion of the urethra, along which it sends a prolongation that connects it with the pelvic fascia, the levator ani, and Wilson's muscles. The superficial fascia of the perinæum is attached to its anterior surface behind the posterior edge of the transverse muscles.

The triangular ligament strengthens the rest of the structures which assist in closing up the inferior outlet of the pelvis, and it serves to support the canal of the urethra. It also frequently forms one of the principal obstacles to the introduction of the catheter, when that operation is not skilfully performed. This ligament is divided to a considerable extent in the lateral operations of lithotomy.

* *Vide* London Med. Surg. Journ. 1833, p. 491.

To expose Cowper's glands and the arteries of the bulb, the anterior lamina of the triangular ligament must be removed.

The *glands of Cowper* are two small bodies of the size and figure of a large pea; they are situated immediately below the membranous part of the urethra, on each side of the mesial line, inclosed between the layers of the triangular ligament. The structure of these bodies resembles that of the other conglomerate glands, consisting of several small granules of a pale ash-colour aggregated together; their ducts are so small as to admit with difficulty the introduction of a bristle; they traverse the coats of the urethra very obliquely, and open into the inferior surface of that canal about an inch and a half in front of the triangular ligament. These glands are sometimes so small that it is with great difficulty they can be displayed.

Cowper's glands are frequently enlarged in cases of stricture of the urethra, and are occasionally the seat of abscesses. I have found the left one divided after the lateral operation of lithotomy had been performed.

The *arteries of the bulb* are two branches of considerable size, which are commonly given off by the internal pudic vessels opposite the opening in the triangular ligament which transmits the membranous portion of the urethra. When this is the case, there is little risk of their being divided in the lateral operation of lithotomy, if the incisions be not made too high when exposing the groove of the staff. Occasionally, however, they run much lower down, and it may then be impossible to avoid wounding them.

To dissect the membranous portion of the urethra and the prostate gland, &c. without making a section of the pelvis.—When the dissector is desirous of obtaining a view of the membranous portion of the urethra, and the structures which surround the neck and base of the bladder, and is not allowed to do so by following the usual method of making a lateral section of the pelvis, he may nevertheless effect his object by adopting the following plan, which consists in separating the rectum from its connexions, and depressing it towards the sacrum and coccyx. The advantages of this plan are the facility of its performance, the little disfigurement of the body which ensues,—circumstances which are frequently of considerable importance—and a more accurate conception of the depth of the perinæum, and the dis-

tance from the surface at which the base of the prostate gland usually lies, than can be acquired, perhaps, by any other means.

For this purpose, the triangular ligament must be divided by carrying an incision across from one tuberosity of the ischium to the other, passing between the bulb of the urethra and the rectum. In making this incision, Cowper's glands and the arteries of the bulb need not be injured. Those of the fibres of the levator ani muscle which descend upon the sides of the prostate gland and rectum must be also divided, in order that the lower part of the intestine may be depressed upon the coccyx. By a little dissection, the membranous portion of the urethra, and the mode in which it is nearly surrounded by the fibres of Wilson's muscles, when they exist, may be shown, as they lie in the interval between the posterior surface of the triangular ligament and the apex of the prostate gland. Immediately behind these structures is the prostate gland itself, and the extent to which it may be safe to cut the left lobe of the gland in the lateral operation of lithotomy may now be determined; the incision in the adult can seldom exceed with safety an inch in length, and its direction should be obliquely downwards and outwards, corresponding with the longest diameter of the gland.

In making this dissection it will be observed how loosely the rectum is connected to the prostate gland and base of the bladder; a circumstance which will explain the frequent occurrence of those mistakes, mentioned by all writers upon lithotomy, in which the gorget or the forceps have been thrust repeatedly between the bladder and the rectum, and the patient allowed to die with a stone in his bladder that ought to have been extracted had the operation been properly performed. I have seen this happen once, in an operation which I witnessed while abroad; the mistake was discovered in time and corrected, after which the stone was extracted: the patient, who was a young boy, recovered very well.

A little behind the base of the prostate gland are situated the vesiculæ seminales; and close along the inner sides of these will be found the vasa deferentia, as they descend upon the base of the bladder, in their course from the testicles to the point where they terminate in the prostatic portion of the urethra. They will be observed to converge towards each other as they approach the base of the prostate gland, where they are placed

nearly in contact. Between the vasa deferentia, a very small portion of the base or "bas-fond" of the bladder is exposed to view, which is the point where the surgeon should enter his trocar, when performing the operation of puncturing the bladder from the rectum. This space will be observed to be extremely small, so that considerable caution is requisite on the part of the operator to avoid injuring either the prostate gland which is in front, the peritonæum which is behind, or the vesiculæ seminales and the vasa deferentia which lie on each side.

In post-mortem examinations, the bladder, prostate gland, and greater part of the urethra may be removed from the body without causing any external disfigurement, and consequently without any violence to the feelings of the friends, who frequently object to the removal of valuable morbid specimens, only upon the ground of the unseemly appearance which might be given to the body of their deceased relative: the removal is effected by cutting out the diseased parts with a knife introduced into the rectum.

CHAPTER II.

SECTION I.

DISSECTION TO EXPOSE, BY A LATERAL VIEW, THE ORGANS CONTAINED IN THE CAVITY OF THE PELVIS.

An incision should be made, in the direction of the linea alba, from the upper part of the symphysis pubis to the umbilicus, and another from the latter point to the spinous process of the fourth lumbar vertebra. The flap which has been thus marked out may be dissected from the peritonæum, (which should remain intact,) and reflected downwards upon the thigh. As it is usual to perform the operation of lithotomy upon the left side, it need scarcely be said that these incisions should be also made upon the same side of the body. Detach now the peritonæum from the iliac fossa, and expose the fascia which covers the iliacus internus and psoas magnus muscles ; trace this fascia over the brim of the pelvis as far as the neck of the bladder, and upon the rectum, where it becomes gradually weaker until it can hardly be distinguished from the subserous cellular tissue. Separate this, which is the pelvic fascia, and the fibres of the levator ani muscle, from their attachments to the left os innominatum, which may then be detached by sawing it across at a little distance from the symphysis pubis, and dividing the ligamento-cartilaginous substance which forms the bond of union between it and the sacrum ; not forgetting to divide also the ilio-lumbar ligament. The bone, together with the obturator internus muscle, and the fascia that covers it, is to be removed altogether ; leaving, however, the spinous process of the ischium, with the fibres of the levator ani, which have their origin from it. While doing this, as much of the left crus penis and of the triangular ligament of the urethra is to be retained as is possible, by cutting the soft parts close to the branches of the os pubis and the ischium of the left side. In this stage of the dissection, besides the structures which have been already mentioned, some

of the fibres of the gluteus maximus, and of the pyriformis and coccygeus muscles, must be divided, together with the sciatic nerves and the larger branches of the internal iliac artery and vein which issue from the pelvis by the great sacro-sciatic notch. Dissect the fibres of the levator ani from their attachment to the posterior surface of the os pubis, and reflect the muscle with the spine of the ischium downwards, so as to expose the prostate gland, membranous portion of the urethra, and the middle portion of the rectum. After this, the pelvic fascia should be traced, and it will be found that at the base of the prostate gland it divides into two laminæ ; one of which, and it is the weakest, ascends and covers the bladder and first portion of the rectum ; whilst the other, much the stronger, forms a sheath for the prostate gland and the vesiculæ seminales, and is continuous along the membranous portion of the urethra, and the middle division of the rectum, with the posterior surface of the triangular ligament of the urethra.

When the pelvic fascia has been thus followed in all its extent, remove the coverings or sheaths which it furnishes to the prostate gland and membranous portion of the urethra ; expose also the muscular coat of the horizontal or middle portion of the rectum, the vesiculæ seminales, the vasa deferentia, and the ureter. Lay open now the peritonæum, in order to show the point where that membrane is reflected from the rectum upon the posterior surface of the bladder, and measure the distance of this reflection from the base of the prostate gland, and from the external surface of the perinæum.

When these directions have been executed, the parts which remain exposed to view are the following, and they may be examined separately in detail. In front is the cut surface of the bone of the pubis, and posteriorly the cartilaginous surface of the sacrum, by which it was united to the ilium ; underneath is the coccyx. Below the symphysis pubis is seen the triangular ligament, containing, between the two layers of which it is composed, Cowper's glands, the arteries of the bulb, and, according to Mr. Guthrie, some muscular fibres. In front of this ligament are the bulb of the urethra and the last portion of the rectum, which are separated from one another by a small triangular-shaped interval (the *recto-urethral triangle*), which is occupied by the central point of the perinæum, some cellular

tissue, and the superficial fascia as it passes behind the transverse muscles of the perineum to join the triangular ligament; still more anteriorly are observed the body of the penis, with the left crus cut from the ramus of the pubis which has been removed, and the scrotum. Behind the triangular ligament are the greater part of the membranous portion of the urethra,

EXPLANATION OF PLATE IV.

This represents the view of the parts in the male pelvis, as obtained by removing the os innominatum of the left side.

1. The os pubis of the left side divided by the saw, about half an inch from the symphysis.
2. The sacrum. The figure is placed upon the cartilaginous surface of the bone, by which it was articulated with the left os ilii, which has been removed.
3. The spinous process of the ischium, which has been sawn across and left attached to the pelvic fascia. The hook is inserted into the pelvic fascia, which it holds gently upon the stretch.
4. The penis lying against the right thigh.
5. The scrotum.
6. The suspensory ligament of the penis.

a. The bladder slightly distended.
b. The prostate gland.
c. The membranous portion of the urethra.
d. The bulb of the urethra.
e. The crus penis of the left side, which has been cut from its attachment to the branch of the ischium.
f. The levator ani muscle of the left side dissected from its attachments to the sides of the rectum and bladder, from which it has been turned down, it conceals the coccyx.
g. *h*. *i*. mark the rectum. The letter *g*. is placed upon the first portion of the intestine; *h*. upon the second, or horizontal portion; and *i*. upon the third, or oblique.
k. The anus.
l. The triangular ligament of the urethra.
m. The pelvic fascia inserted upon the base of the prostate gland.
n. Cowper's gland of the left side.
o. The ureter of the same side.
p. The vas deferens, cut across where it is leaving the side of the bladder in its course to the internal abdominal ring.
q. The vesicula seminalis.
r. *r*. *r*. The divided edge of the peritonæum covering the posterior surface of the bladder and the rectum. The cul-de-sac which this membrane forms where it passes from the rectum upon the bladder, is seen to be situated near the posterior extremity of the vesicula seminalis, and not far from the base of the prostate gland.
s. The trunk of the common iliac artery cut across in making the section of the pelvis.

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and the prostate gland; above these the anterior ligaments of the bladder; below them the middle or horizontal portion of the rectum; and still farther behind are situated the bladder, vesiculæ seminales, and the perpendicular portion of the rectum, covered by the peritonæum, which passes from it upon the posterior surface of the bladder. (See Plate IV.)

The *peritonæum*, where it passes from the rectum upon the posterior surface of the bladder, forms, on each side of the cul-de-sac which it presents here, two folds, which have been named the posterior ligaments of the bladder, though without any good reason, for they are rather calculated to facilitate the changes which are produced in the position of this viscus, by its different states of repletion and vacuity, than to maintain it in any one fixed relation.

The peritonæum is reflected from the posterior surface of the bladder at its summit, where the ligamentous remains of the urachus ascend to the umbilicus. On each side, the vasa deferentia and umbilical arteries limit the extent to which this membrane covers the bladder.

The distance from the base of the prostate gland at which the peritonæum is reflected from the rectum upon the posterior surface of the bladder, is sometimes not more than one quarter of an inch; so that it may be wounded by an incautious operator in performing the operation of puncture of the bladder from the rectum.

A layer of cellular tissue,* of a very loose and easily distensible nature, is placed underneath the peritonæum, and separates it from the pelvic fascia; this cellular tissue allows the changes of relative position which so frequently take place between the bladder and rectum to be very easily effected. In corpulent subjects this tissue is much loaded with adipose substance, which renders it difficult to distinguish it from the pelvic fascia, which, in such cases, is very thin and delicate.

The *pelvic fascia* (recto-vesical fascia, fascia pelvica) is the membrane which lines the whole of the cavity of the pelvis, and is placed between the peritonæum and the muscles. To expose it, it is only necessary to remove the peritonæum and subserous cellular tissue; which may be done with the handle

* The subserous cellular tissue,—fascia propria of the French anatomists.

of the scalpel. The pelvic fascia is a continuation of the same membranous structure which is called, where it lines the parietes of the inguinal region, *fascia transversalis*, and upon the iliacus and psoas muscles, *fascia iliaca:* as it passes over the brim of the pelvis it is very thin and weak, and it is with great difficulty that it can be separated from the periosteum of the bones, to which it closely adheres. As the pelvic fascia descends behind the symphysis of the pubis, and upon the levator ani muscles, it becomes much stronger and is easily traced upon the sides of the bladder and rectum, upon which it is gradually expanded. The pelvic fascia is pierced by the several vessels and nerves which leave the cavity of the pelvis for the supply of the lower extremities and the genital organs; each of these structures receives an investment or sheath from the fascia as they pass through it, which may be traced a short distance along their course.

On each side of the symphysis pubis the pelvic fascia presents two thick and strong processes, which extend from the bodies of the ossa pubis to the neck of the bladder, lying above the prostate gland. These processes are about an inch long, and have been named the *anterior ligaments of the bladder;* they connect some of the muscular fibres of the bladder to the posterior surface of the ossa pubis.

Between the anterior ligaments of the bladder, the pelvic fascia presents a slight depression, which corresponds with the upper surface of the membranous portion of the urethra and prostate gland; underneath this depressed part of the pelvic fascia will be found the continuation of the dorsal veins of the penis, after they have passed through the triangular ligament to join the prostatic plexus.

When the pelvic fascia reaches the neck of the bladder, it divides into two lamellæ, of which the superior one is much the thinner, and ascends upon the muscular parietes of that organ, which it invests; the other end is much stronger and thicker, descends upon the prostate gland which it envelopes, as it were, in a perfect sheath, and may thence be followed along the membranous portion of the urethra as far as to the posterior margin of the opening by which that canal passes through the triangular ligament, where it becomes continuous with the posterior layer of that structure.

A large number of veins run in the substance of the sheath which the pelvic fascia furnishes to the prostate gland; these veins are called the *prostatic plexus*. It is not very unfrequent to find small calcareous concretions, or phebolites, as they are termed, in the interior of these veins.*

There are several cases recorded where the division of these veins, in the operation of lithotomy performed upon old people, has been followed by a considerable hæmorrhage; they are sometimes also the seat of phebitis, which indeed, according to many of the French writers of the present day, is to be regarded as one of the principal causes of death after that operation.

Where the pelvic fascia is traversed by the rectum, it divides into two layers also, one of which ascends, and the other descends, upon the muscular fibres of the intestine. It is in this manner that the pelvic fascia separates the bladder, the membranous portion of the urethra, with the prostate gland and the vesiculæ seminales, from the horizontal portion of the rectum, upon which they are supported. If this part of the pelvic fascia be now removed, the vesiculæ seminales and the vasa deferentia may be shown as they lie in the interval between the convex surfaces of the base of the bladder and the rectum.

The pelvic fascia is in relation superiorly with the peritonæum and the subserous cellular tissue; inferiorly, or by its external surface, with the obturator fascia, the fibres of the levatores ani, pyriformes and coccygei muscles, as well as the several structures to which, as has been already mentioned, it furnishes separate investments. The fascia also serves to strengthen this part of the walls of the abdomen, and to prevent the more frequent occurrence of hernia either in the perinæal region, or by the sacro-sciatic and thyroid openings; moreover, it assists in maintaining the viscera of the pelvis in their respective situations. The strongest part of the fascia is at the point where it is attached to the base of the prostate gland and the neck of the bladder; here it is considered by many to form the chief obstacle to the occurrence of infiltration of urine into the cellular

* "The formation of phlebolites is a remarkable example of the gradual conversion of the fibrine of the blood in the veins into isolated, round, or ovoid bodies of a strong hardness."—Dr. Carswell's Pathol. Anat. art. Analogous tissues.

tissue of the pelvis, after the lateral operations of lithotomy; and hence the anxiety of many surgeons to avoid injuring it at this situation, while dividing the prostate gland with the knife or gorget. The incision or laceration of the prostate gland must extend beyond the base of the gland, and reach the base of the bladder, before infiltration of urine into the subserous cellular tissue of the pelvis can take place.

The *prostate gland* is a firm fleshy body, placed in front of the neck of the bladder, which it embraces by its base or larger circumference. The figure of the prostate is heart-shaped, or, as is more commonly said, resembles that of a large chestnut; the base or broad part being directed posteriorly, whilst its apex, which is truncated, looks towards the arch of the pubis, from which it is distant about half an inch: here it surrounds the commencement of the membranous portion of the urethra.

The prostate gland is somewhat flattened or compressed upon the superior and inferior surfaces, and is much more prominent on either side; from which circumstance it is usual to describe it as consisting of two lobes,—the *lateral lobes* of the prostate, as they are called.

In some subjects the posterior border of the prostate gland is more irregular in its outline than in others, and a small portion of its substance is found projecting between the vasa deferentia previous to their entering the body of the gland: this has been described as another lobe, and is named the *third* or middle lobe of the prostate by Sir Everard Home, who first described it, and who considered that the retention of urine, which is so common in old men, was generally caused by a morbid growth of the *third lobe;* an opinion, however, which is not universally adopted at the present day, since it has been frequently shown that the tumour which causes the retention of the urine alluded to, is a distinct growth, and wholly independent of this portion of the prostate.

The prostate belongs to the class of conglomerate glands, as being composed of minute granules aggregated together by a very dense and strong tissue. Its ducts, which are very numerous, open into the floor of the prostatic portion of the urethra, on each side of the *verumontanum* or *caput gallinaginis*. It is by no means an unfrequent occurrence to meet with numbers of small calculi, of a dark brown colour, interspersed in the sub-

stance of the gland. They are formed in the ducts, and consist, as has been found by analysis, of phosphate of lime; these calculi sometimes acquire a considerable size. When the prostate gland is cut, the section presents a firm, resistant, and striated surface, which is not unlike in its appearance, especially in elderly people, to that of a scirrhous tumour. The structure of the prostate is very lacerable, and admits of being extended to a very great degree.

Relations—by its inferior surface, with the middle portion of the rectum; superiorly, with the anterior ligaments of the bladder; and, on each side, with the fibres of the levatores ani, which descend from the posterior surface of the ossa pubis to the central point of the perinæum, and have been named the *compressor prostatæ*, — in front with Wilson's muscles, and the membranous portion of the urethra; behind, with the neck of the bladder. The gland is closely invested in a sheath or capsule, which is furnished by the pelvic fascia; underneath, or in the thickness of which, run the prostatic plexus of veins, which have been already alluded to.

In some instances, which are happily, however, of rare occurrence, the internal pudic artery, instead of pursuing its usual course, runs along the side of the prostate gland; and would be almost inevitably divided in the lateral operation of lithotomy, if performed under such circumstances. Sometimes it is a large branch of the internal iliac artery which runs in this unusual course.*

The urethra runs through the prostate in such a manner that it is much nearer to the superior than the inferior surface of the gland; though some exceptions have been noticed to this very general rule. The common ejaculatory ducts, which result from the union of the vasa deferentia with the ducts of the vesiculæ seminales, also traverse the greater part of the substance of the gland, as they run in an oblique direction forwards and upwards

* In a man who was operated upon by the late Mr. J. Shaw, and who died of hæmorrhage soon after the operation, it was found that the source of the bleeding was this anomalous distribution of the arteries; a large branch of the internal iliac artery ran along the side of the prostate gland, and had been cut by the knife in opening the neck of the bladder.—Ed. Journ. of Med. Science, vol. ii. 1826.

to the point where they open into the floor of the prostatic portion of the urethra, underneath the verumontanum.

In children the prostate gland is exceedingly small, while in elderly persons it very frequently becomes very much enlarged. Owing to its peculiar figure, its diameters are of very unequal extent; thus, if measured from the urethra, where it is passing through the gland, to the circumference of the base, we shall have superiorly a radius of not more than three or four lines, inferiorly about four or six; on each side, in a transverse direction, six or eight lines; whilst in an oblique direction downwards and outwards, which is that of the incision to be made in the lateral operation of lithotomy, we shall find the radius to be from nine to twelve lines in length.

There is scarcely, perhaps, any point in surgery which has been more disputed than the question, What ought to be the extent to which it is proper to carry the incision of the prostate gland in the lateral operation of lithotomy? This is a question that still remains undecided; although in this country the majority of surgeons appear inclined to adopt the opinion that it is more safe in general not to extend the incision so far as to divide the whole of the base of the prostate gland, as by thus limiting the section, the chances of infiltration of urine into the subserous cellular tissue of the pelvis will be less than when the base of the prostate gland is divided, together with the reflection of the pelvic fascia which is connected with it.

The prostate gland is sometimes the seat of abscesses, the contents of which may be discharged by the collections of pus bursting either into the rectum or the urethra. Tuberculous deposits have been noticed in the substance of the gland.

The *vas deferens* is the long and narrow tube which conveys into the urethra the seminal fluid secreted by the testicle. It leaves the other component structures of the spermatic cord at the internal abdominal ring, and, after crossing over the epigastric artery, descends along the side of the bladder, running in the angle which is formed by the reflection of the peritonæum from the posterior surface of the bladder upon the sides of the pelvis. In the latter part of this course it crosses the ureter at nearly right angles, passing upon its inner side; and then, inclining more towards the mesial line, runs along the inner border of the corresponding vesicula seminalis, with the duct of which it unites at the base of the prostate gland. The vas deferens is accom-

panied in the whole of its course by a very small artery, which is a branch of the vesical artery. Near to its termination the vas deferens becomes considerably enlarged, and somewhat tortuous in its figure, and the calibre of the tube, which is extremely small in the greater part of its extent, here becomes much increased and sacculated in its figure, so as to present, when cut open, a honeycombed appearance. The external coat is of very great thickness; and so firm, that it is easy to distinguish the vas deferens from the other components of the spermatic cord by the hard wiry sensation which it communicates to the fingers when the cord is handled: internally, the vas deferens is lined with a delicate mucous membrane.

The *vesiculæ seminales* are oblong-shaped cellular bodies, situated one on each side of the base of the bladder, behind the prostate gland. They are enclosed in a sheath derived from the pelvic fascia, and lie in the interval between the convex surfaces of the rectum and base of the bladder. Their external surface is very irregular, from the sacculated form of their interior, which is composed of numerous cells that communicate freely with each other. The larger extremity, which is directed posteriorly, is separated by a considerable interspace from the base of the opposite vesicula; while their anterior extremities, which are narrow, and end in the ducts that join with the vasa deferentia, are only separated from one another by the breadth of these vessels, and by the middle lobe of the prostate gland when it exists. The structure of the external coat of the vesiculæ seminales appears to be similar to that of the vasa deferentia, but is much thinner; the internal coat is composed of mucous membrane.*

According to some authors, the vesiculæ seminales form reservoirs for the seminal fluid secreted by the testicles; though there are several points of difference between their contents, as found after death, and the semen itself. It was the opinion of John Hunter, that the vesiculæ seminales did not receive semen from the vasa deferentia. The fluid which they contain is usually clear, of a viscid or glairy consistence, and of a darkish brown colour.

The *common seminal ducts* (ducti ejaculatorii) are two in

* Not long since, in examining the body of a man who died in the hospital, we found the vesiculæ seminales ossified. The preparation is now in the Museum of the College.

number; they are formed by the junction of the duct of the vesicula seminalis on each side with the corresponding vas deferens; their length is about an inch, and they run obliquely forwards and upwards, through the substance of the prostate gland, to the point at which they terminate by opening into the prostatic portion of the urethra. As they run parallel with each other in their course through the gland, they are not likely to be wounded in the lateral operation of lithotomy; but one or both must in all probability be divided in the recto-vesical method.

The *membranous portion of the urethra* is the narrowest part of the canal, and extends from the apex of the prostate gland to the bulb of the urethra; its length is about one inch when measured upon the superior surface; but it appears to be somewhat less than this inferiorly, on account of the bulb of the urethra here encroaching upon it. The triangular ligament divides the membranous portion of the urethra unequally, the larger part being behind, placed between the ligament and the prostate gland. This part, which is surrounded on the sides and inferiorly by Wilson's muscles when they exist, is also in very close apposition with the middle division of the rectum, which renders it useful to depress the intestine with the forefinger of the left hand, in order to avoid injuring the coats of the bowel, while the groove of the staff is being exposed with the knife in the operation of lithotomy.

The membranous portion of the urethra is invested by a sheath from the pelvic fascia, which joins with the posterior layer of the triangular ligament around the margins of the opening by which the canal passes through. Cowper's glands are also closely situated beneath it, and the dorsal veins of the penis run along the upper surface in their way to join with the prostatic plexus.

What is the nature of the structure which lies between the mucous membrane of the membranous portion, and the sheath which it receives from the pelvic fascia? According to some, it is a vascular or erectile tissue; while in the opinion of others it is of a muscular nature; of which latter character, indeed, it has generally appeared to me to partake most. If this be the case, the old name of *muscular portion*, which was formerly given to it, would appear to be more applicable than the present one.

The *bladder* is the musculo-membranous reservoir that serves to contain the urine during the intervals of its evacuation from the body. It lies behind the bones and symphysis of the pubis, and in front of the first or perpendicular division of the rectum, resting upon the middle portion of the gut. When the bladder and rectum are empty, the space between them is usually occupied by some of the folds of the small intestine, which then descend into the pelvis. The figure of the bladder is not always the same, for it differs considerably according to the age and sex of the individual, and also in the opposite conditions of repletion and vacuity. In children the bladder is of pyriform figure, and is situated much more in the hypogastric and the umbilical regions than in the cavity of the pelvis, which it occupies in the adult, when it is also of a rounded or ovoid shape.

The bladder in the adult, when empty, lies closely behind the pubis, and in this condition must be greatly protected from injury from external violence; but, when it is distended with urine, the upper part of it rises above the edge of the pubis, and lies behind the lower part of the recti muscles.

For the purpose of description, the exterior of the bladder may be divided into four surfaces or regions, to which may be added its summit and base.

The *anterior surface* is separated from the pubis by a quantity of loose cellular and adipose tissue, and extends, from the insertion of the urachus into the summit of the bladder, to the upper edge of the prostate gland, where the anterior ligaments fix it more firmly to the bones of the pubis. This part of the surface of the bladder is uncovered by peritonæum; and upon this circumstance is founded the practice of puncturing the bladder above the pubis in some cases of retention of urine, and also the high operation of lithotomy. That these operations may be performed with safety, it is necessary, however, that the bladder should be considerably distended.

In thin persons it is always easy to determine whether the bladder is distended or not, by the tumour which it forms in the hypogastric region; but the case is very different in corpulent individuals, in whom the belly is more than usually prominent: in these circumstances the diagnosis is frequently extremely difficult and obscure.

The *posterior surface* is inclined very obliquely downwards

and backwards, extending from the urachus to the point where the peritonæum is reflected from the rectum upon the bladder. The posterior surface is covered in the whole of its extent by the peritonæum. Some of the folds of the small intestine usually separate it from the first portion of the rectum, except when the bladder is very largely distended.

When the bladder is ruptured by a fall or from a blow upon the lower part of the belly, the rent is usually situated in some part of the posterior surface ; which is probably to be attributed to the unyielding nature of the peritonæum which covers it at this part.

The *lateral surfaces* are of greater extent inferiorly than superiorly ; the peritonæum covers the sides of the bladder to a very small extent superiorly, as it soon leaves them to be reflected upon the sides of the pelvis, where it forms what are called the *false lateral ligaments* of the bladder : a quantity of loose cellular tissue invests the remainder of the lateral surfaces, and separates them from the pelvic fascia. The vasa deferentia, and the ligamentous remains of the hypogastric arteries, lie in this cellular tissue as they descend obliquely along the sides of the bladder.

The *summit of the bladder*, or, as it is sometimes termed, *the fundus*, may be said to be formed by the junction superiorly of the preceding surfaces. It is covered posteriorly, and partially upon the sides, by the peritonæum. From its centre extends upwards to the umbilicus a fibro-cellular cord, somewhat triangular in its shape, and named the *urachus*. This is the remains of a hollow tube which in the early stages of fœtal existence extends from the bladder to the umbilicus, where it is connected with the membranes of the ovum. Lying between the linea alba and the peritonæum, and having attachment inferiorly to the muscular coat of the bladder, it serves as one of the principal means of retaining the bladder, during its distension, against the posterior surface of the anterior wall of the abdomen. The two ligamentous bands which result from the obliteration of the hypogastric arteries also extend, on each side of the urachus, from near the summit of the bladder to the umbilicus.

The *base of the bladder*, sometimes also called the "*bas-fond*," is that part of the viscus which rests upon the middle portion of the rectum, the vesiculæ seminales, and vasa defer-

entia; it is limited in front by the posterior edge of the prostate gland, and behind by the recto-vesical cul-de-sac of the peritonæum. On each side the ureters pierce the tunics of the bladder obliquely, in their course to reach its interior.

The base, in the adult subject, is the most depending portion of the bladder, and it is much more so in some subjects than in others; so that it not unfrequently occurs that a calculus, especially when of inconsiderable size, may lie so deeply here that it eludes for some time all the attempts of the surgeon to touch it with the sound. From the same circumstances also, some delay may be produced in seizing the stone with the forceps in the operation of lithotomy, as it cannot be reached with the finger. It is of importance to be observed, that the triangular space through which the point of the trocar can be safely introduced into the bladder, when it is punctured from the rectum, is exceedingly limited in its extent; as the cul-de-sac of the peritonæum frequently descends between the vesiculæ seminales much nearer towards the posterior edge of the prostate gland than is commonly supposed from the usual descriptions which are given of it in books.

The *neck of the bladder* (cervix vesicæ) is that part of it which is surrounded by the prostate gland; as it comprises within its limits the greater part of the *trigone vésical*, and is continuous anteriorly with the prostatic portion of the urethra. In infancy this is the lowest part of the bladder; but, in the adult and old subject, the bas-fond most frequently lies upon a plane inferior to it.

The neck of the bladder is cut in the lateral operation of lithotomy.

The *ligaments of the bladder* are several in number, and admit of being divided into two classes, the *true* and the *false* ligaments. The first of these consist of the *anterior* and *lateral ligaments*, formed by the pelvic fascia, as already described. The urachus and the ligamentous remains of the hypogastric arteries also serve the purpose of ligaments by connecting the summit of the bladder to the umbilicus; while inferiorly the membranous portion of the urethra, with the dense sheath which it receives from the pelvic fascia covering the prostate gland, firmly fix its base behind the arch of the pubes.

The latter class, or the false ligaments, are formed by the peritonæum where it is reflected on each side from the posterior sur-

face of the bladder to the iliac fossæ, and by the little folds which project on each side of the recto-vesical cul-de-sac of the same membrane. It is obvious that these do not really deserve the name of ligaments of the bladder, inasmuch as they are rather calculated to facilitate the changes of position consequent upon its distension than to limit or restrict them.

Structure of the bladder.—The coats or tunics of the bladder are three in number; a serous, a muscular, and a mucous. These are united to each other by cellular tissue, which, according to some writers, should be enumerated as two additional coats.

The serous or peritonæal coat forms but a partial investment, since it only covers the posterior and a small portion of the lateral surfaces of the bladder. The extent of this covering upon the sides of the bladder appears to be determined by the course of the vasa deferentia, whilst the urachus limits it superiorly. The cellular tissue that unites the peritonæum to the muscular coat is of a very lax nature, so as to allow of the free motion of the bladder underneath it during its distension. The muscular coat is composed of three layers, each of which pursues a different direction; the fibres of the first set are disposed in a longitudinal course, and appear to extend from the neck of the bladder and anterior ligaments over the whole surface of the viscus. Some of these are also attached to the urachus and to the ureters for a little distance from the bladder. The fibres of the second set are for the most part arranged in a transverse direction, while those of the internal or third layer present a reticulated appearance. This arrangement of the muscular fibres of the bladder can be best seen in those cases where they have become increased in thickness and strength, in consequence of some obstruction to the easy exit of the urine, as in cases of inveterate stricture of the urethra. In such cases, the internal surface of the bladder frequently presents a honeycombed appearance from the large size of the muscular fibres.

Many persons have been deceived into the error of stating the existence of calculus in the bladder, when none in reality existed, by mistaking the sensation, which the rough internal surface of a bladder in this condition is capable of communicating to the touch, for that produced by the contact of the staff with a stone.

In some instances, the mucous membrane of the bladder is

protruded in the intervals between the muscular fibres in such a manner as to form distinct pouches or little sacs, in which calculi are sometimes deposited.

It may be mentioned, however, that the fibres of one stratum are not altogether distinct from those of the others; but that they frequently intermingle and are interlaced with each other at different points.

Some circular fibres have been noticed by Sir Charles Bell as surrounding the orifice of the urethra, and have been named by him the *sphincter muscle* of the bladder; but these are not always found to present very distinctly the appearance that he has described.

When the interior of the bladder has been laid open by a longitudinal incision made upon its anterior surface, the mucous membrane that lines it may be next examined. It is continuous with the mucous membrane which lines the ureters and the urethra. When the bladder is empty and contracted, the mucous membrane is thrown into numerous transverse folds or rugæ. It is very vascular, especially towards the neck of the bladder, where numerous veins are placed underneath it; when healthy, it is of a pale roseate hue. A large number of mucous follicles abound in the region of the neck of the bladder. Underneath the mucous membrane, a layer of cellular tissue is placed, which has been sometimes called the vascular or nervous coat.

The "*trigone vésical*" is the name that has been given to the small triangular space included between the orifice of the urethra in front, and those of the ureters posteriorly. The mucous membrane where it covers this triangular space is perfectly smooth, pale, and seems to be endowed with a more acute sensibility to impressions than any other part of it. The base of the trigone is situated posteriorly, and is formed by a line extending across from the orifice of one ureter to the other. Where the urethra commences, at the apex of the trigone vésical, a small eminence may be observed to project in the mesial line, which has received the name of "*luette vésicale*" or "*uvula vesicæ*."

Sir Charles Bell has described two small fasciculi of muscular fibres which lie underneath the mucous membrane on each side of the trigone, and reach from the orifices of the ureters to the uvula vesicæ, into which they are inserted. These bands have

been named by him the "*muscles of the ureters;*" and may serve to maintain the obliquity of the course of the ureters through the coats of the bladder, notwithstanding the different degrees of distension to which it is subject.

The arteries of the bladder are furnished from the vesical branches of the internal iliac artery, besides a few ramusculi which come from the middle hæmorrhoidal and internal pudic arteries. These vessels are chiefly distributed upon the inferior surface and sides of the bladder.

The veins, which are few and small in the young subject, form in the adult a considerable plexus around the neck of the bladder and prostate gland. They receive the dorsal veins of the penis, with some branches from the sides of the prostate gland and the adjacent structures, and terminate by opening into the internal iliac veins. The veins forming this plexus are frequently varicose in old persons, and thus become capable of furnishing a considerable quantity of blood when cut in the operation of lithotomy.

The nerves of the bladder are partly derived from the sacral plexuses of the cerebro-spinal axis, and partly from the hypogastric plexuses of the sympathetic system.

The *ureters* are the long cylindrical-shaped tubes which serve to convey the urine from the kidneys into the bladder. Each ureter is about eighteen inches long, and of the size of an ordinary quill. In its course the ureter crosses over the upper part of the psoas muscle, passing underneath the spermatic vessels; opposite the base of the sacrum it crosses the common iliac artery and vein near their termination in the external and internal iliacs; and still lower down in the cavity of the pelvis it crosses the vas deferens, which lies upon its inner side near the point where it is about to enter the bladder. The ureters traverse the coats of the bladder very obliquely, and, on arriving upon its inner surface, terminate at the posterior angles of the trigone vésical. Where they pass through the coats of the bladder, the ureters are narrower than elsewhere. In their course the ureters are closely applied to the external surface of the peritonæum, and are carried along with this membrane when it is lifted up from the subjacent structures, as in the operation of placing a ligature upon the common iliac artery. The interior of the ureters is lined with mucous membrane which is continuous with that of the bladder. Some of the muscular fibres of the

bladder may be followed for a considerable distance upon the ureters. Occasionally there are observed two ureters upon one side, which sometimes unite with one another before their termination.

Urinary calculi, as they descend from the kidney to the bladder, frequently excite considerable pain and uneasiness in the upper part of the thigh and testicle, according to the degree of pressure which they exercise upon the nerves of the lumbar and spermatic plexuses as they are crossing over them. Calculi are sometimes arrested at the vesical orifice of the ureter, where they project partially into the bladder; and in this situation may attain a considerable size, and cause some delay and difficulty in their extraction, should the operation of lithotomy be performed under such circumstances.

Where a considerable obstruction has existed for any length of time to the evacuation of the urine, as in cases of old and close strictures of the urethra, stone in the bladder, disease of the prostate gland, &c. the ureters are frequently found to be greatly enlarged in their diameter, and otherwise diseased in their structure.

The *urethra.* — The internal surface of the urethra may be exposed to view and examined by opening the canal through the entire length of its course by an incision which should be carried along its superior wall: this incision is readily made with the scissors, one of the blades of which is to be introduced into the canal. If this is done before the penis and bladder are detached from the pelvis, the relations of the urethra to the surrounding structures, and the curved direction which it pursues, can be studied with much greater advantage than when they have been previously separated.

The urethra extends from the neck of the bladder to the summit of the glans penis, where it terminates by a vertical slit or aperture, which is named the meatus urinarius. The length of the urethra may be said to average between eight and nine inches, though in many instances considerable variations from this standard may be shown to exist. The diameter of the urethra is not exactly the same throughout its extent, but varies considerably at different points. The direction of the urethra is, strictly speaking, curved, though by a little tact a perfectly straight instrument may be carried along it into the bladder. As the penis hangs loosely in front of the scrotum, the urethra presents a

double curvature, which has been likened to the letter S reversed. The first of these curves, or that which is situated in front of the symphysis pubis, is readily effaced by raising the penis upwards until it forms a right angle with the axis of the body; it also disappears in the state of erection of the penis. The second curvature, however, is permanent, and is formed by the urethra bending underneath the arch of the pubis, towards which the concavity of the curve is directed. This last curvature, though constantly present, is not so great as has been imagined by many; but it is liable to be increased by several circumstances, and more especially by enlargement of the prostate gland. The urethra has been divided into three portions, which differ from one another in their structure as well as in their situation and extent; they are the *prostatic portion*, the *membranous portion*, and the *spongy portion*.

1. The *prostatic portion* commences at the neck of the bladder, and extends in an oblique direction from above downwards, and from behind forwards, about twelve or fifteen lines. This is, in the natural condition, the widest part of the urethra. In the middle of its floor a triangular-shaped eminence is observable, which is formed by a duplicature of the mucous and submucous tunics; this is the *verumontanum* or *caput gallinaginis*. On each side of this fold the urethra presents a deep depression — *sinus prostaticus*, into which the ducts of the prostate gland open. By compressing the gland between the fingers, these orifices may be more distinctly seen, by the whitish fluid, which is the secretion of the gland, being thus made to issue from them: they are about fifteen or twenty in number. The orifices of these ducts are sometimes considerably dilated, and then may become an obstacle to the passage of a small catheter, from the point of the instrument becoming entangled in them. A slight depression is to be seen upon the anterior surface of the verumontanum, which is named the *sinus pocularis*, and within the margins of which the common ejaculatory ducts open, commonly by two separate orifices which are situated one on either side of the mesial line. The extremity of a small catheter is sometimes obstructed in its passage at this point also; and, if force is used, a false passage will be the result. The extremities of the prostatic portion of the urethra are usually narrower in their diameter than the intervening space.

2. The *membranous portion* of the urethra extends from the apex of the prostate gland to the bulb; its length is about one inch, though, as has been mentioned previously, it appears to be less if measured upon its inferior surface, in consequence of the depending position of the bulb of the urethra. The membranous portion is the narrowest part of the urethra, its diameter seldom exceeding three or four lines. Its direction is slightly curved, the centre of the curvature being at the point where it passes through the opening in the triangular ligament of the urethra, the concavity being directed upwards.

3. The *spongy portion* is the longest of the divisions of the urethra, for it extends from the orifice of the urethra to the anterior surface of the triangular ligament, a distance of six or seven inches: placed in the greater part of its extent underneath the corpora cavernosa of the penis, it presents two remarkable enlargements at each extremity; the anterior of which forms the glans penis, the posterior the bulb of the urethra.

The bulb of the urethra occupies the greater part of the space which exists below the crura of the penis; and is formed mainly by a large quantity of erectile tissue, which chiefly abounds upon the inferior surface of the canal. The bulb is directed obliquely upwards and forwards, and is surrounded by the fibres of the accelerator urinæ muscle. It is continuous anteriorly with the spongy body of the urethra. Internally, the urethra presents a remarkable dilatation opposite the bulb, which is chiefly observable upon the inferior surface of the canal; this dilatation has received the name of the *sinus of the bulb*, and forms one of the principal obstacles to the introduction of the catheter. According to most writers, the usual situation of stricture of the urethra is between the bulb and the commencement of the membranous portion.

Where the urethra passes through the glans penis, it presents a considerable dilatation—the *fossa navicularis;* in the under surface of which is a large lacuna—the *lacuna magna*, which will frequently admit the point of a small catheter.

The external orifice of the urethra is, perhaps, the narrowest part of the canal, and certainly the least dilatable; which is owing to a layer of firm cellulo-fibrous tissue being placed around it, underneath the mucous membrane.

Structure of the urethra.—The internal surface of the

urethra is lined with a delicate mucous membrane, which is continuous with that which lines the interior of the bladder; it is naturally of a light colour, and presents, when the urethra is not artificially distended, numerous longitudinal folds or plicæ. A number of small foramina are observable upon various parts of its surface, the greater part of which are placed along the inferior wall, and are also rather larger than the rest; they are the orifices of the little mucous crypts or lacunæ of the urethra. These lacunæ open very obliquely upon the surface of the urethra, and are directed from behind forwards; so that the urine, in its passage along the canal, passes over them without entering into their cavities. The mucous membrane of the urethra is easily torn; but it is strengthened by a layer of condensed cellular tissue, which is placed externally, and separates it from the other structures which surround the canal. In the prostatic portion of the urethra, the mucous membrane is additionally supported by the firm structure of the prostate gland; in the membranous portion, by a layer of muscular and vascular tissue, and the sheath which it receives from the pelvic fascia. From the bulb to the external orifice, the erectile tissue of the corpus spongiosum surrounds it; though very little of this is found upon the upper part of the canal, except as it is passing through the glans.

When the urethra does not open, as is usual, upon the extremity of the glans penis, but upon some part of the under surface of the organ, the variety is called *hypospadias;* this abnormal state is much more frequent in its occurrence than that in which the urethra opens upon the dorsum of the penis, between the gland and the pubes, which deformity has received the appellation of *epispadias.*

Before the bladder and urethra are removed, the levator ani muscle and the internal pudic artery should be examined as they lie within the pelvis, together with such of the branches of the internal iliac vessels as are connected with the urinary organs.

To expose the inner surface of the levator ani, the bladder and rectum must be drawn downwards to the left side, and the pelvic fascia divided in the middle of the space between the point where it quits the side of the pelvis, and its reflection upon the sides of the bladder and rectum: by turning away on

either side the flaps of the fascia, the fibres of the muscles may be clearly displayed upon their inner surface.

The *levator ani* muscle arises in front from the posterior surface of the ossa pubis, a little above the arch, and, a little more externally, from a tendinous band which stretches from the symphysis pubis to the spinous process of the ischium ; this band is placed in the angle that is formed by the separation from one another of the pelvic and obturator fasciæ. A few of the fibres of the muscle arise from the spine of the ischium itself, and are soon inserted into the side of the coccyx ; those of the muscular fibres that spring from the tendinous band just now mentioned descend obliquely towards the mesial line, and are inserted into the raphé or fibrous band which extends between the extremity of the coccyx and the anus, where they are united with the corresponding fibres of the opposite side ; the rest are inserted into the side of the rectum, near its termination, after passing between the muscular coat of the intestine and the external sphincter of the anus. The fibres from the ossa pubis descend upon the sides of the prostate gland and the membranous portion of the urethra, underneath which they unite with each other. This muscle is thick and fleshy in its middle, and at its insertions ; a few tendinous fibres are intermingled at its origins. The superior surface of the levator ani is lined in great measure by the pelvic fascia, and supports the middle portion of the rectum, the bladder, and prostate gland ; its external surface is covered with a thin fascia, which is prolonged upon it from the inferior border of the triangular ligament of the urethra, and which separates it from the adipose substance that occupies the ischio-rectal fossæ. This muscle assists by its action in the expulsion of the fæces and urine. Those of its fibres that descend upon the left side of the prostate gland are divided in the lateral operation of lithotomy.

Wilson's muscles (compressor urethræ) are two small bands of muscular fibres which arise from the posterior surface of the os pubis on each side of the symphysis, and, descending upon the sides of the membranous portion of the urethra, unite with each other underneath the canal.* These muscles are not

* See a description of two muscles surrounding the membranous part of the urethra. By James Wilson, F.R.S. Medico-chirurgical Trans. vol. i. p. 175.

always as distinct in some subjects as in others; and in most can scarcely be said to differ from the anterior fibres of the levator ani.

These muscles may, by a spasmodic contraction of their fibres, diminish the calibre of the membranous portion of the urethra, which they almost surround; and thus form a temporary obstruction to the exit of the urine, or to the introduction of a bougie or catheter into the bladder.

The muscle of the left side is divided in the lateral operation of lithotomy.

THE RECTUM.

The *rectum* is the last portion of the large intestine, and has probably derived its appellation from the straight form which it usually presents in the lower animals. In the human subject the rectum, although it is less curved than many other parts of the intestines, presents nevertheless several changes in its course which are deserving of notice, since they ought to be borne in mind during the introduction of bougies in the treatment of strictures of this part of the alimentary canal. The most remarkable of these curvatures are in the direction of the long axis of the bowel. The rectum is about twelve inches, sometimes a little more, in length; it extends from the termination of the sigmoid flexure of the colon, which is situated in the left iliac fossa, to the anus. At its commencement the rectum is placed opposite to the left sacro-iliac articulation; but as it descends it inclines a little towards the right; so as to reach the mesial line opposite the curved part of the sacrum, where it again changes its direction, which hitherto has been nearly vertical, and becomes horizontal; which new direction it continues to hold until it arrives opposite the extremity of the coccyx, where it again bends upon itself, inclining downwards and backwards to reach its termination at the anus. The two last-mentioned curvatures of the rectum may be said to divide the bowel into three portions, the direction and relations of which greatly differ from one another.

The first or superior portion is about five or six inches in length, and extends from the commencement of the bowel as far as opposite the lower third of the sacrum. Its direction is nearly

vertical, though it presents, as has been already mentioned, a slight inclination from left to right as it descends into the cavity of the pelvis. This portion of the rectum lies loosely in front of the sacrum, being invested for more than three-fourths of its circumference by the peritonæum, which is then reflected upon the sides of the pelvis, forming a large duplicature, the *meso-rectum*, between the layers of which the superior hæmorrhoidal vessels, with some nerves and cellular tissue, are situated.

The middle portion of the rectum is nearly horizontal in its direction, and is between three and four inches in length. It rests upon the lower part of the sacrum, the coccyx, and coccygeal muscles: its anterior surface is partially covered at first by the peritonæum; after which it is only separated by some cellular tissue from the vesiculæ seminales, vasa deferentia, and the small portion of the base of the bladder which lies between them; towards its termination it is in close contact with the prostate gland and the posterior part of the membranous portion of the urethra.

The peritonæum covers this division of the rectum upon its anterior and lateral surfaces only at its commencement, being soon reflected from it upon the posterior surface of the bladder, forming thus the *recto-vesical cul-de-sac* of the peritonæum. The remainder of this portion of the intestine lies imbedded in a quantity of cellular and adipose tissue, and receives an investment from the pelvic fascia which maintains it fixed in its position upon the sacrum and coccyx.

The third portion of the rectum is the shortest, as its length does not exceed one inch and a half; it extends, in an oblique direction downwards and backwards, from the extremity of the coccyx to the anus. It is surrounded by the fibres of the external sphincter and levatores ani muscles, and supported by the prolongation backwards of the triangular ligament of the urethra. In consequence of the direction backwards of this portion of the rectum, a small triangular-shaped interval is left between it and the bulb of the urethra *(the recto-urethral triangle)*; its base is formed by the cutaneous surface of the perinæum in front of the anus, and the apex is situated near the anterior extremity of the prostate gland. The first incisions in the bilateral operation of lithotomy are carried across this triangular space, which is occupied chiefly by some adipose tissue.

Internal surface.—The mucous membrane of the rectum is very thick and vascular; it is usually found to present a great number of folds or rugæ, the larger proportion of which are disposed transversely, while some others are directed longitudinally, and have been called the *columns of the rectum.* Some of the transverse folds are much more prominent than the rest, and have been described by Mr. Houston as having the appearance of valves.* Indigestible substances, that have been accidentally swallowed with the food, such as fish-bones, &c. the surfaces of which are irregular and pointed, are sometimes arrested in their progress through the rectum by some of the numerous depressions which abound upon the internal surface of the intestine, especially just within the anus: these foreign bodies excite irritation by their presence, and may lead to the formation of abscesses, which frequently end in the establishment of a fistula in ano. The middle portion of the rectum is much wider than either of the other divisions of the bowel, and occasionally mounts very high upon each side of the prostate gland, which then appears to be sunk as it were into the upper surface of the intestine. Near the anus the cavity of the rectum becomes suddenly constricted; hence the radiated appearance of the folds of the mucous membrane in this situation.

The mucous membrane of the rectum is connected with the middle or muscular coat by a layer of cellular tissue, so lax and extensible in its texture as to allow, not unfrequently, of the displacement of the first to a considerable degree, without being accompanied by any alteration in the position of the last. This is the case in most forms of prolapsus ani.

The *muscular tunic* of the rectum is formed of two layers of fibres which follow different directions; the external or superficial layer is composed of fibres disposed longitudinally;

* According to Mr. Houston, "*three* is the average number of these valves; sometimes four, and sometimes only two, are present in a marked degree. The position of the largest and most regular valve is about three inches from the anus, opposite the base of the bladder. The fold of next most frequent existence is placed at the upper end of the rectum. The third in order occupies a position about midway between these; and the fourth, or that most rarely present, is attached to the side of the gut, about one inch above the anus. The form of these valves is semilunar; their convex borders are fixed to the sides of the rectum, occupying in their attachment from one-third to one-half of the circumference of the gut."—See Observations on the Mucous Membrane of the Rectum, by J. Houston, Dub. Hosp. Rep. vol. v. p. 158.

these are very strongly developed, and present a uniform surface all round the intestine; the internal layer, on the contrary, consists of circular fibres, the most inferior of which being more closely aggregated together and stronger than the rest, have, in consequence of this difference, been sometimes described as the internal sphincter muscle of the anus.

The *arteries of the rectum* are furnished from three distinct sources: the inferior mesenteric artery furnishes the *superior hæmorrhoidal;* the internal iliac artery gives off the *middle hæmorrhoidal arteries;* and the *inferior* or *external hæmorrhoidal* come from the internal pudic arteries as they are running along the inner surface of the tuberosities of the ischia. The trunk of the superior hæmorrhoidal artery is placed upon the posterior surface of the first portion of the intestine, between the layers of the meso-rectum; the middle hæmorrhoidal run chiefly upon the lateral surfaces of the middle portion; while the inferior hæmorrhoidal ramify around the circumference of the anus.

The *veins* of the internal coat of the rectum form the radicles of the inferior mesenteric vein, and are thus continuous with the vena portæ; hence they are frequently dilated in diseases of the liver and of the heart: upon which circumstance is founded the practice, which prevails so much in France, and elsewhere upon the continent, of applying leeches around the anus in affections of these organs.

The *nerves* of the rectum are furnished partly from the hypogastric plexus of the sympathetic system, and partly from the sacral plexus of the spinal nerves.

THE INTERNAL PUDIC ARTERY.

The *internal pudic artery* arises from the internal iliac almost immediately after the sciatic artery has been given off from that vessel. Sometimes, however, the internal pudic and the sciatic arteries spring together from a common trunk, which is a branch of the internal iliac. After a short course, the internal pudic artery leaves the cavity of the pelvis, passing out through the great sacro-sciatic notch, running, as it emerges, between the inferior border of the pyriformis muscle and the spinous process of the ischium. As it thus escapes from the

cavity of the pelvis, the great pudic artery lies internal and a little anterior to the sciatic artery and nerve. In this, the first part of its course, the artery is situated in front of the pyriformis muscle and the sacral plexus of nerves, and behind the posterior surface of the bladder and the vesicula seminalis, to both of which structures it furnishes a few small branches. In the second part of its course, the internal pudic artery crosses over the posterior surface of the spinous process of the ischium near to its extremity, and immediately afterwards re-enters the pelvis by the smaller sacro-sciatic opening, passing at the same time upon the inner surface of the tendon of the obturator internus muscle. Where the artery crosses the spine of the ischium, it is covered by the skin, some of the fibres of the gluteus maximus muscle, and by the great sacro-sciatic ligament. In this part of its course it gives off a few delicate branches, which ramify in the soft parts surrounding the hip-joint.

If an incision of three or four inches in length is made over the spine of the ischium in the direction of the fibres of the gluteus maximus muscle, by separating some of these fibres and cutting across the great sciatic ligament, the vessel can be exposed and a ligature passed around it. This is an operation, however, that has hitherto been practised only upon the dead body. In a case mentioned by Dr. Harrison, in his work upon the arteries, considerable benefit resulted from the employment of pressure over this part of the course of the internal pudic artery. The case was one that occurred in St. Thomas's Hospital, under the care of Mr. Travers; the patient was very emaciated, and much reduced by an alarming hæmorrhage from a phagedenic ulcer upon the glans penis, which had resisted all the topical means that had been previously employed.*

When the internal pudic artery has re-entered the pelvis, it runs forwards and a little upwards in a gently curved direction as far as the inferior border of the sub-pubic ligament, where it turns sharply forwards to reach the dorsal surface of the penis, along which it runs to arrive at the base of the glans penis, where it terminates by dividing into several small branches for the supply of it and the prepuce. Between the point where it re-enters the pelvis, and the junction of the branches of the ischium and

* See Surgical Anatomy of the Arteries, by R. Harrison, M. D. vol. ii. p. 101.

pubis, the artery lies very deeply, being placed against the inner surface of the obturator internus muscle, the fleshy fibres of which separate it from the bone. Here the artery, with its accompanying veins and nerve, are inclosed in a dense sheath, which is formed by the splitting into two layers of the fibres of the obturator fascia. The artery when injected may be felt with the finger about an inch above the lower edge of the tuberosity of the ischium, where it is completely removed from the direction of the incisions which are made in the lateral operation of lithotomy, so that there is no chance of its being wounded in this part of its course. But when the artery has arrived opposite the junction of the branches of the ischium and pubis, it approaches much nearer to the mesial line, and lies in the angle between the margin of the descending branch of the pubis and the triangular ligament of the urethra (as may be seen in the wood-cut at page 21), where it is in some degree overlaid by the crus penis. In this situation the artery has been frequently wounded during the operation of lithotomy, in consequence of the blade of the knife or gorget not having been directed sufficiently obliquely while making the section of the prostate gland and neck of the bladder; for if the edge of the instrument is directed transversely outwards instead of being inclined obliquely downwards, it is difficult to conceive how the requisite opening can be made into the bladder without wounding the artery at this spot.

When the internal pudic artery has been cut during the operation of lithotomy, and the hæmorrhage that ensued was serious, the vessel has been secured lower down by means of a flexible curved needle introduced deeply into the ischio-rectal fossæ, where it was carried round the vessel as it runs along the inner surface of the obturator internus muscle.

Branches of the internal pudic artery. — In addition to the ramusculi which the internal pudic artery furnishes in the first and second parts of its course, it gives off several large and important branches as it runs from the lesser sacro-sciatic notch to the under surface of the arch of the pubis; these are as follows:

1. The *arteriæ hæmorrhoidales externæ* are two or three in number, and spring from the trunk of the internal pudic artery as it is running along the external wall of the ischio-rectal fossæ; they pierce the obturator fascia immediately after their

origin, and cross the adipose mass which fills up the interval between the tuberosity of the ischium and the inferior extremity of the rectum, upon which they are finally distributed. In their course across the ischio-rectal fossæ, they furnish several small branches to the adipose tissue; whilst their terminal branches form a vascular chain around the anus by anastomosing with each other, the transversales perinæi, and the middle hæmorrhoidal arteries.

These arteries in the healthy state of the parts about the anus are very small, and when divided, as they sometimes are in the lateral operation of lithotomy, seldom give any trouble from hæmorrhage; but the case is different when they have been wounded in the operations which are performed for the cure of fistulæ in ano, or the removal of tumours in this region. In such circumstances they are frequently enlarged, and do not retract as usual in consequence of the thickened and condensed state of the tissues; and if care is not taken either to ligature them, or to close their orifices with a well-applied compress, the patient is almost sure to lose a considerable quantity of blood after he becomes warm in his bed, when the reaction consequent upon the operation has set in.

2. *Arteria superficialis perinæi.*—This is a branch of considerable size; it arises from the internal pudic artery opposite the posterior border of the transverse muscle of the perinæum, underneath which it commonly turns in its course to reach the triangular space between the accelerator urinæ and erector penis muscles, in which it runs in rather a tortuous manner until it reaches the scrotum, to the coats of which it is finally distributed. As this artery runs between the muscles above-mentioned, it gives small branches for the supply of both, as well as to the cutaneous coverings of the perinæum.

As the direction of the course of this artery is parallel to that of the external incision made in the lateral operation of lithotomy, it frequently escapes being wounded. No precise rule, however, can be given by which it may be surely avoided by the knife; which circumstance is the less to be regretted, as its division is seldom followed by any important hæmorrhage.

3. *Arteria transversalis perinæi* is sometimes a branch from the preceding, and given off from it as it is about to cross

the transverse muscle. This artery runs along the posterior edge of the muscle just named, until it reaches the central point of the perinæum, where it divides into smaller branches, which anastomose with the vessel of the opposite side, and with the external hæmorrhoidal arteries between the bulb and the rectum.

This vessel is cut across in the lateral operation of lithotomy; but its size is too insignificant to deserve any attention.

4. *Arteria corporis bulbosi* is the most important of the branches of the internal pudic artery; it is a short but large vessel, and is given off by the internal pudic as it is passing opposite the attachment of the crus penis to the bone. After its origin, it runs transversely inwards, placed between the layers of the triangular ligament; and, near the margin of the opening which transmits the membranous portion of the urethra, it enters the bulb, and is distributed to the erectile tissue of the corpus spongiosum urethræ. A little before *entering* the bulb, this artery gives one or two small branches to Cowper's glands. (See the wood-cut at p. 21, figures 6, 6.)

When the artery of the bulb pursues the course that has been just described, it is not liable to be divided by the knife in the operation of lithotomy, unless the incisions are made much too high, and the urethra opened upon the staff much further from the prostate gland than is proper. But in some instances the artery of the bulb arises from the internal pudic much nearer the tuberosity of the ischium, and then it runs so obliquely upwards and inwards in its course to reach the bulb, that, should the operation of lithotomy be performed, the vessel can scarcely escape being wounded.

It is believed by many surgeons, that the severe hæmorrhage which sometimes follows the performance of the lateral operation of lithotomy is more frequently the consequence of a wound of the artery of the bulb, than of the internal pudic, as commonly supposed.

5. *Arteria corporis cavernosi penis.*—This branch springs from the internal pudic artery as it runs under the inner edge of the crus penis, into which it immediately enters, and then runs forward in the corpus cavernosum, inclining towards the septum pecteniforme, upon which it ramifies. This artery supplies the

erectile tissue of the cavernous body of the penis, and anastomoses with the corresponding vessel of the opposite side, through the apertures of the septum.

6. *Arteria dorsalis penis.*—When the internal pudic artery has ascended as high as the inferior border of the sub-pubic ligament, it turns forwards, and, after traversing the suspensory ligament of the penis, runs along the upper surface of that organ as far as the corona glandis, where it divides into branches which are distributed to the prepuce and gland. In its course along the dorsum of the penis, the artery lies close to the mesial line; and is included, together with its accompanying nerve and vein, in a sheath formed of the fibrous investment of the corpus cavernosum penis. The dorsal arteries, and the arteries of the corpora cavernosa, usually require the employment of the ligature after amputation of the penis.

Varieties.—The most important variety of the internal pudic artery is that in which this vessel does not leave the pelvis by the great sacro-sciatic notch; but, instead of doing so, runs along the base of the bladder and side of the prostate gland. If the operation of lithotomy were to be performed upon an individual in whom this variety existed, the artery would certainly be cut, and death would probably ensue from the hæmorrhage. It is said that this accident occurred some years ago in one of the hospitals in London.

The *internal pudic veins* and *nerves* correspond in their course and distribution with the branches of the artery, with the exception of the dorsal vein of the penis, which passes through an aperture in the triangular ligament of the urethra immediately below the sub-pubic ligament, and then joins the prostatic plexus.

The *lymphatics* of the perinæum join with those of the scrotum, and open into the glands of the groin: those of the penis are divided into two sets; one of which is deep-seated, and follows the course of the internal pudic vessels, while the other set is superficial, and, commencing upon the surface of the glans and prepuce, runs along the dorsum of the penis, and joins the inguinal glands.

THE UMBILICAL ARTERIES.

The *umbilical arteries* form in the fœtus the continuation of the trunks of the internal iliac arteries, and are during that period much larger than the external iliac arteries. These vessels serve to carry the blood from the body of the fœtus back to the placenta, so that in their functions at least they more resemble veins than arteries. The umbilical arteries run along the sides of the bladder in a curved direction, the concavity of the curve being directed upwards; they extend from opposite the sacro-iliac symphysis to the umbilicus, where they emerge from the body of the fœtus, and constitute a part of the umbilical cord, being coiled in a spiral manner round the umbilical vein. On reaching the placenta they terminate in numerous ramifications, which enter the substance of that structure. In their course within the pelvis, these vessels lie in the cellular tissue which covers the sides of the bladder; as they pass from the summit of the bladder to the umbilicus, they are placed between the peritonæum and the recti muscles, where they may be observed to form two prominent lines, one on each side of the urachus, when the cavity of the abdomen has been laid open by a transverse incision.

After birth, that portion of the vessels which extends between the umbilicus and the sides of the bladder is gradually obliterated, and they assume the appearance of small but dense ligamentous cords, which may tend in some degree to maintain the bladder in its natural position. Posteriorly a very small portion of the artery, now much reduced in its size, remains pervious to the current of blood, which it distributes by several small branches to the inferior and lateral surfaces of the bladder. Thus the proportions that existed between the umbilical arteries and the external iliacs in the fœtus become completely reversed in the adult.

SECTION II.

DEVELOPEMENT OF THE PERINÆUM.

In the first stages of intra-uterine existence, the perinæum of the male presents an open hollow or cleft in the mesial line, which causes it to resemble at this period the vulva of the female. This condition of the parts may remain permanently, in consequence of an arrest of the progress of development, and then the individual will present the appearances which have been so frequently observed in one class of those persons who are exhibited to the public as hermaphrodites.

As the formation of the urethra proceeds gradually from behind forwards, its completion may be arrested at any point ; and thus the external orifice of the canal, instead of being situated, as is usual, at the extremity of the glans penis, is placed upon some part of the inferior surface of the organ, constituting the malformation denominated *hypospadias*.

The urinary bladder, in the fœtus, is situated rather in the hypogastric region of the abdomen than in the cavity of the pelvis, and reaches nearly as high as the umbilicus. Sometimes the anterior surface of the bladder is wanting, and then the lower part of the linea alba is deficient also ; so that the mucous membrane of the bladder protrudes upon the external surface, a little above the pubes, under the form of a red vascular tumour, near the centre of which the orifices of the ureters may be distinguished, and the urine seen to distil from them.* In such cases the urethra is commonly incomplete.

Several instances are recorded in which the urachus remained pervious after birth, and permitted the urine to escape from the umbilicus.

The lower part of the rectum is sometimes wanting, and this defect may be accompanied or not with the absence of all appearance of the anus. In these cases there is sometimes a communication between the rectum and the bladder. When the lower part of the rectum is thus deficient, the surgeon may

* In the course of last winter, a middle-aged man, who was the subject of this malformation, which is termed *extrophy of the bladder*, was for some time a patient, under Mr. Liston, in the University College Hospital.

occasionally succeed in his endeavour to reach the closed extremity of the bowel, by making an incision cautiously in the direction of the hollow of the sacrum, and so afford an exit to the fæcal contents of the alimentary canal. The child rarely survives the operation, however successful it has been, many days.

OF SOME OF THE MORBID CHANGES IN THE LOWER PART OF THE RECTUM.

The term "hæmorrhoids" comprises several varieties of tumours around the lower extremity of the rectum. In some instances the tumour is simply a dilatation or true varix of one or more of the veins of the bowel; while in others it is formed by the extravasation of blood into the cells of the submucous cellular tissue, consequent upon a rupture of the affected vessel. The cavities thus formed may continue to communicate with the interior of the vessel that has been ruptured, and may increase in their size by a repetition of the extravasation; or they may cease to be connected with the interior of the vein, and assume the characters of an isolated and solid mass, by the condensation and thickening which result from repeated attacks of inflammation. In a third variety a vascular substance is generated in the cellular tissue surrounding the margin of the anus, which resembles, when it is cut with the knife, the structure of erectile tissue in many of its characters. Hæmorrhoids or piles are named external or internal, according as they are covered by the common integument of the margin of the anus, or by the mucous membrane of the intestine.

It is best to remove external piles by excision with the knife or scissors; but, when the tumour is within the bowel, the ligature is more advisable, as there is a great risk of severe hæmorrhage following the use of the knife in such cases. After the application of the ligature, considerable benefit results from the practice of cutting off the summit of the strangulated tumour.

Verrucæ circa anum.—These are soft, indolent, fleshy growths, which frequently occur about the anus in consequence

of irritation from discharges of different kinds. Thus they are very frequently met with in women who have suffered long from gonorrhœa. In many instances verrucæ around the anus are not to be considered as being produced in consequence of a constitutional venereal taint, while in others it can hardly be doubted that they are as much so as any other secondary symptom.*

Fistula in ano.—The majority of abscesses that form in the vicinity of the anus, when allowed to run their course uninterrupted, degenerate, after the discharge of their contents, into an indolent sinus, which extends to a variable distance alongside of the bowel. When the fistulous tract opens only externally, it is called a *blind external fistula;* and, on the contrary, when the sinus opens into the interior of the rectum, without having any aperture upon the surface, it is named a *blind internal fistula.* Sometimes the sinus opens by one extremity into the rectum, and by the other upon the skin; this constitutes a *complete fistula.* The operation for the cure of this disease consists in dividing the structures which intervene between the fistula and the cavity of the rectum, including the sphincter muscles, the action of which being thus suspended for a time, the surfaces of the wound remain at rest and heal by granulation.

Prolapsus ani usually consists in the protrusion through the anus of the relaxed mucous membrane of the rectum; but there are other conditions of the bowel which are sometimes included under this term, and in one of these the upper part of the intestine descends into the lower, resembling an intussusception: the mucous, muscular, and peritonæal coats of the gut form part of the protruded mass, which has been known to have been cut off, and the patient to lose his life in consequence of the opening thus made into the abdominal cavity.†

* M. Ricord, the surgeon of the Hôpital des Vénériens at Paris, considers that the verrucæ around the anus, which sometimes follow a chancre, are sufficient evidences of the constitution having become affected by the venereal virus. They are frequently accompanied by painful ulcerations in the clefts between the toes. The best treatment consists in the local application of the solid nitrate of silver.

† See a Treatise on the Diseases of the Urethra, Vesica Urinaria, Prostate, and Rectum, by Sir Charles Bell, Lond. 1822, description of plate v.

CHAPTER III.

OF THE INTRODUCTION OF THE CATHETER.

Among the number of those who are entering upon their studies in the schools, there are perhaps few to be found who are not ready to assert that they consider the introduction of the catheter as an operation of very trifling importance, and of such easy execution that they do not hesitate to undertake its performance with a perfect assurance of succeeding in their attempt: and although they are quite willing to admit that they are utterly unacquainted with the anatomy of the urethra, and the numerous structures by which it is surrounded, yet they possess, as they think, a sufficient ground for their opinion in the fact that they have already performed the operation many times without encountering any impediment. Nevertheless their success must be regarded as purely accidental, and unworthy of the degree of confidence which is placed in it; and it would prove of much advantage if students could be early persuaded of the necessity that exists of diligently turning their attention to the examination of the structure and direction of the canal, along which they propose to introduce an instrument into the bladder.

To a knowledge of the anatomy of the urethra should be added a frequent practice of the operation itself, and with this view every opportunity of introducing the catheter in the dead body ought to be taken advantage of; since by so doing the hand becomes accustomed to distinguish the different parts of the urethra, and the obstacles which they naturally oppose to the passage of the instrument; and thus are gained lightness of touch, and tact in adopting the best methods of avoiding these obstacles without doing an injury to the delicate lining membrane of the urethra,—acquirements which are of far more value and importance than all the information that can be derived from simply reading the descriptions of others.

By so acting, any one, when he has to treat a case in which

difficulties occur, owing to the alterations from the natural direction and dimensions of the urethra, which are so frequently induced by disease, will be at least able, if he cannot succeed in his endeavour to pass the catheter, to avoid doing more mischief by rude and ill-directed efforts than it may be in the power of his seniors in the profession to repair. "I do not know," says Mr. John Bell, "that even the operation of lithotomy itself is more difficult than that of introducing the catheter; more important it cannot be than an operation which gives relief in accidents and difficulties so extremely common and so very afflicting. There is no operation with which I should more earnestly entreat the young surgeon to make himself acquainted than this of introducing the catheter."*

Catheters are of various shapes and materials: some are flexible, others are inflexible; and these may be either curved or straight, according to the choice of the operator. The instrument in most general use is, as is well known, of silver, and of such a degree of curvature as nearly to correspond with the form of the canal along which it has to pass. Generally speaking, when other circumstances are not opposed to it, a large catheter is preferable to one of small size, as it distends the parietes of the urethra, and is much less likely to be obstructed by any of the irregularities which the internal surface of the canal presents at different points of its extent. Straight catheters have been more frequently used in late years, especially since the introduction of the operation of lithotrity, which has been very much indebted to this circumstance for its present improved condition.

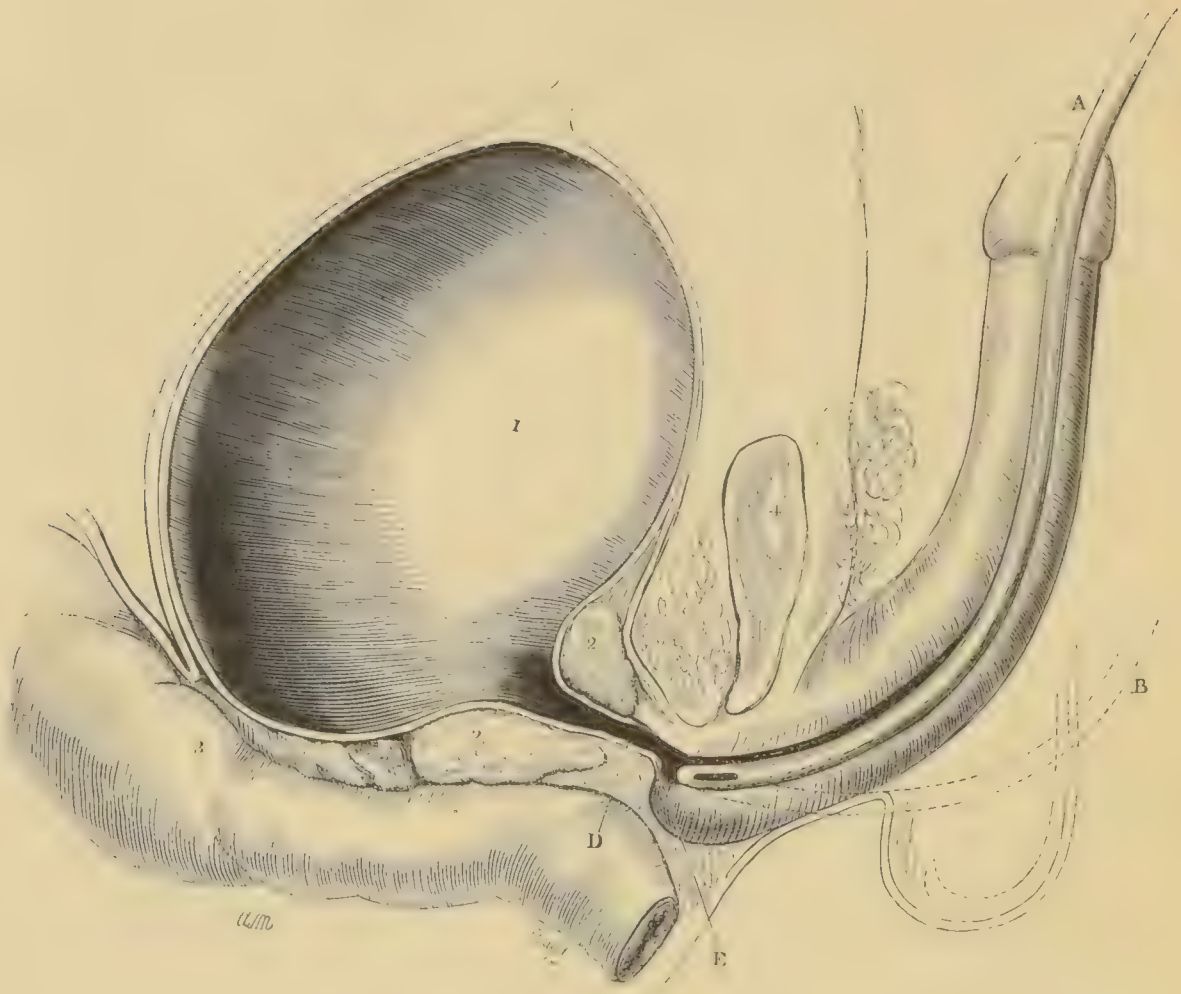
Introduction of the ordinary curved silver catheter.—Sometimes the instrument is introduced when the patient is standing, and then he ought to be placed in front of the surgeon, with his back to the wall, so that he may not change his position during the operation; when he is lying in bed, he should be placed flat upon his back, in a perfectly straight position, with the knees slightly raised and apart from one another. The operator, standing upon the left side of the bed, takes hold of the penis with the thumb and fore-finger of the left hand, and raises it gently, so as to efface the curve or angle which the penis forms

* Vide Principles of Surgery, by John Bell, Surgeon, vol. iv. p. 210.

where it bends down in front of the scrotum. Holding the catheter in his right hand, lightly poised between the thumb and two first fingers, the surgeon introduces its point into the orifice of the urethra, and continues to pass the instrument onwards until the point reaches the bulb, which is about an inch below the arch of the pubes. During this time, the concavity of the catheter is directed towards the symphysis pubis, while the straight portion of it is held parallel with the front of the abdomen. The point of the catheter having reached the bulb, the position of its handle is now to be changed from the horizontal direction in which it has hitherto been held, until it has been brought into a perpendicular position, and thus forms a right angle with the axis of the patient's body ; this movement of the handle of the catheter will cause its point to rise out of the sinus of the bulb, after which it may be safely pushed onwards through the opening in the triangular ligament of the urethra, and thus enter into the membranous portion of the canal. (See the annexed wood-cut, B and E.) By gradually depressing at this time the handle of the catheter a little more between the thighs of the patient, it will glide smoothly onwards through the remaining portion of the urethra into the bladder.

The operation, as has been just described, may be divided into three periods, as follows: — In the first period, the point and curved part of the catheter are held in a perpendicular position while it is introduced along the urethra as far as the bulb, at the same time that its handle and straight portion are maintained in a horizontal position parallel with the anterior surface of the abdominal parietes : in the second period, the handle is raised from the horizontal into the vertical position ; at the same time its point also rises a little, and is thus disengaged from the sinus of the bulb, and enters the membranous portion of the urethra, passing through the circular opening in the triangular ligament : in the third period, the handle of the instrument is still further depressed between the patient's thighs, while the point continues to ascend slightly, and, following the curve of the membranous and prostatic portions of the urethra behind the symphysis pubis, enters the bladder.

In this manner of introducing the catheter, it will be observed that the handle and point of the instrument describe each a curve at the same moment, the respective extent of which is



The engraving of the section of the pelvis represents the time when the handle of the catheter should be depressed in order to disengage its point from the sinus of the bulb. It is sometimes necessary to withdraw the catheter a few lines, and carry its point closer up along the superior surface of the urethra.

Figure 1, is the bladder. 2. 2. The prostate gland : the vesicula seminales is seen behind the gland. 3. The rectum. 4. The cut surface of the symphysis pubis. A. The catheter introduced into the urethra as far as the bulb. B. The dotted line which indicates the direction in which the handle of the catheter is to be depressed in order to disengage the point from the depression of the bulb. E. The inferior margin of the opening in the triangular ligament of the urethra, and against which the point of the catheter frequently hitches. D. is another point at which the catheter is sometimes obstructed.

very different : that is to say, the handle of the instrument describes a segment, nearly one-half of a large circle, in the same time that the point travels more slowly over a segment of a circle of much smaller diameter.

Many surgeons direct that, in the first period of introducing the catheter, the handle of the instrument should be turned at first obliquely towards the left groin of the patient, from which position it is gradually to be brought into the mesial line as its point approaches the bulb of the urethra.

It is by no means absolutely requisite to take hold of the penis with the left hand during the introduction of a catheter, as the operation can be done equally well without touching the penis at all. Where, however, there is a stricture in the anterior part of the urethra, considerable advantage will be obtained from holding the penis forwards with the left hand, as it renders the canal in front of the obstruction quite straight, and maintains it perfectly steady, so that the point of the catheter may be pressed with much greater exactness and effect against the obstacle. In these cases, also, it will be found useful sometimes to support the parietes of the urethra, by placing the fingers of the left hand underneath the canal externally, opposite the situation of the strictured part. Beyond the triangular ligament, it is evident that no degree of traction of the penis can exercise any useful influence upon that part of the urethra which intervenes between it and the bladder.

There is another mode of introducing the catheter, which, however, is seldom practised at the present day, though it used formerly to be in great repute; it has been named the *Tour de Maître*. This method possesses really no advantages over that which has already been described, and is perhaps rather calculated to render the operation less easy, by the chances which it affords to the point of the catheter of diverging from the direction of the axis of the urethra, at the moment when the attention of the operator is engaged by the movement which must be given to the handle. The *Tour de Maître* consists in introducing the catheter or staff, with its concavity at first directed downwards; the convexity of the instrument being turned towards the pubes. The catheter is held in this position until its point reaches the bulb of the urethra.

Here the point of the catheter must remain perfectly steady while the handle is carried round from left to right with a rapid sweeping movement, describing a large semicircular curve, the centre of which is represented by the point of the catheter as it rests in front of the circular aperture in the triangular ligament

of the urethra. When this rotatory movement has been executed, the handle of the catheter is to be depressed between the patient's thighs, as in the ordinary method, so that its opposite extremity may follow the direction of the curve of the membranous and prostatic portion of the urethra. The chief difficulty in the execution of the *Tour de Maître* consists in maintaining the point of the catheter perfectly steady during the rapid and sweeping movement of its handle, making it, as it were, the pivot or centre upon which the rest of the instrument revolves.

The *Tour de Maître* is most frequently employed when the staff is introduced after the patient has been bound in the position for the lateral operation of lithotomy.

Introduction of a straight catheter.—When the patient is lying upon his back, which is the position for the operation of lithotrity in which straight instruments are most frequently employed, the operator, holding the penis in the usual manner between the fingers of the left hand, raises it until it forms a right angle with the trunk of the patient's body; he then introduces the instrument into the urethra, in a perpendicular direction, until its point reaches the sinus of the bulb, when he lowers the catheter and the penis together, and brings them down between the thighs of the patient until they are reduced into the horizontal position; then, after first withdrawing the instrument about two or three lines in order to free its point from the sinus of the bulb, he pushes it gently onwards into the bladder, continuing, if it is necessary, to depress still more the handle of the instrument, which will frequently facilitate the passage of the point along the membranous and prostatic portions of the canal.

The natural obstacles which most frequently oppose themselves to the passage of the catheter are, first, the lacunæ of the urethra, and the sinus of the bulb; after which comes the margin of the opening in the triangular ligament. When these are passed, the anterior border of the prostate gland, the orifices of its ducts, and the sinus pocularis, may all serve to obstruct the introduction of a small catheter, by entangling its point; and, lastly, the elevated ridge which marks the commencement of the neck of the bladder. It will be observed, that nearly all these natural obstacles to the easy introduction of a catheter are situated upon the inferior surface of the urethra,

and therefore they will be best avoided by keeping the point of the catheter gently directed against its superior wall. The margins of the opening in the triangular ligament will not give any trouble if the situation of the circular aperture that transmits the urethra is accurately understood; it is nearly one inch below the arch of the pubes, and equi-distant from the descending branches of the same bones.* When the point of the catheter is arrested in either the membranous or the prostatic portions of the urethra, it will be found of considerable advantage to introduce the left fore-finger into the rectum, which will frequently enable the operator to distinguish the situation, as likewise the cause of the difficulty, and also to direct the instrument with greater certainty into the bladder.

There are two errors which are very frequently committed by those who are not experienced in the introduction of the catheter: the first of these is, to hold the catheter much too stiffly in the hand; for it is not an uncommon sight to observe the handle of the catheter grasped as firmly as one would a dagger, instead of handling it as lightly as a pen. The consequence of this error is, that if the point of the instrument should happen to be arrested by any obstacle to its passage along the urethra, it is immediately forced through the delicate lining membrane of the canal, and a false passage is thus commenced. The second error is, to observe the general rule of keeping the point of a catheter, during its introduction, directed against the upper surface of the urethra, too strictly, whereby it is liable to be arrested in its progress by the superior margin of the opening in the triangular ligament, or, if it passes here, at a little distance farther onwards by the edge of the prostate gland.

False passages are most commonly made where the surface of the urethra presents some inequality, either upon its surface or in the density of the structures which surround it. It is from these circumstances that they are most frequently commenced in the sinus of the bulb, or in the membranous and prostatic portions of the canal. False passages may also originate from the point of a small catheter being entangled in some one of the numerous lacunæ of the urethra. Where the canal is more constricted, and its parietes thicker and stronger at any

* See the woodcut at p. 21, fig. 7.

spot than is natural, as is the case in stricture of the urethra, false passages are frequently made in front of the diseased part. It requires the exercise of much less force than is commonly supposed to produce a false passage in the urethra. A peculiar grating sensation is communicated to the touch as soon as a catheter leaves the urethral canal, or enters a false passage that has been already made. In cases of enlarged prostate, a false passage is not unfrequently made through the diseased mass.

Some skilful surgeons have considered the formation of a new passage to be justifiable when the prostate gland is so much enlarged as to alter and distort the course of the urethra, where it traverses the gland, to such a degree that no instrument can be made to pass along it into the bladder. In several cases this practice of establishing a new route for the urine appears to have been attended with no bad results.*

The reason why false passages are so frequently made without any extravasation of urine occurring afterwards, is doubtless that the urine does not easily find an entrance, on account of their oblique direction from before backwards, which is the reverse of that of the stream of urine.†

Extravasation of urine may occur in consequence of a rupture of the bladder, or of the urethra: when the bladder is ruptured, the laceration is commonly situated in that portion of its surface which is covered by the peritonæum, and death is the certain result from the peritonitis which ensues. In other instances the bladder is torn either on the sides or at its base, and then the urine is extravasated into the subserous cellular tissue of the abdomen. In such cases, also, death generally soon follows the accident. If the rupture occurs in some part of the urethra, which is posterior to the bulb, and in front of the triangular ligament, the urine escapes into the cellular tissue which separates the muscles of the penis from the superficial fascia of the perinæum. The urine as it escapes is prevented from diffusing itself backwards towards the anus by the attachments of the superficial fascia

* It is said that the celebrated physician Astruc was thus treated by Lafaye, and lived a considerable time afterwards.

† Sir Charles Bell, who has offered this explanation in his excellent treatise upon the diseases of the urethra, illustrates it by contrasting the difference in this respect between a rupture of the urethra in front of a stricture, and one which takes place behind it.—*Hospital Reports, by Sir C. Bell, p.* 98.

to the triangular ligament of the urethra; and, on each side, by its insertions into the internal edge of the branches of the ischia and ossa pubis. In such cases the urine distends the perinæum, and then proceeds forwards, underneath the dartos, into the scrotum; thence, if the extravasation continues, it ascends upon the lower part of the abdomen, passing between the superficial fascia of the inguinal regions and the tendon of the external oblique muscles. This is the ordinary course of the extravasated fluid under these circumstances; but I have seen it spread backwards upon the buttocks and ischio-rectal fossæ, and downwards upon the thighs as far as the knees. The case is a desperate one when the urine is extravasated into the cellular structure of the corpus spongiosum urethræ.

In cases of extravasation of urine, early and free incisions should be made into the distended parts; and, where it can be done, a gum catheter should be introduced into the bladder, and allowed to remain there during the cure.

Sometimes a patient comes to the hospital who has received a blow upon the perinæum: he is in great pain and cannot pass his urine, and the perinæum and the scrotum are largely distended; the latter is also quite of a black colour. This appearance is owing to extravasation of blood following the rupture of one of the arteries of the scrotum in consequence of the blow. In this case incisions need not to be made, as the blood will be quickly absorbed under milder treatment.

Puncture of the bladder from the rectum.—Cases of retention of urine may occur in which the catheter cannot be passed into the bladder, and the operation of puncturing the bladder must be had recourse to for the relief of the patient. When this operation is performed from the rectum, the patient is placed in the same position as for the operation of lithotomy; and the surgeon introduces the two first fingers of his left hand into the intestine, until he feels the posterior edge of the prostate gland. A long curved trocar is then carried along the fingers; and as soon as the extremity of the cannula has passed beyond the prostate, the handle of the instrument is to be depressed, and the stilette pushed onwards, so as to enter it into the bladder, passing through the small space which is included between the recto-vesical cul-de-sac of the peritonæum and the vasa deferentia. The cannula, or a piece of gum catheter, should be left in the wound for several hours after the operation, to

prevent the wound from closing too quickly. This operation should only be practised when the prostate gland is not very much enlarged.

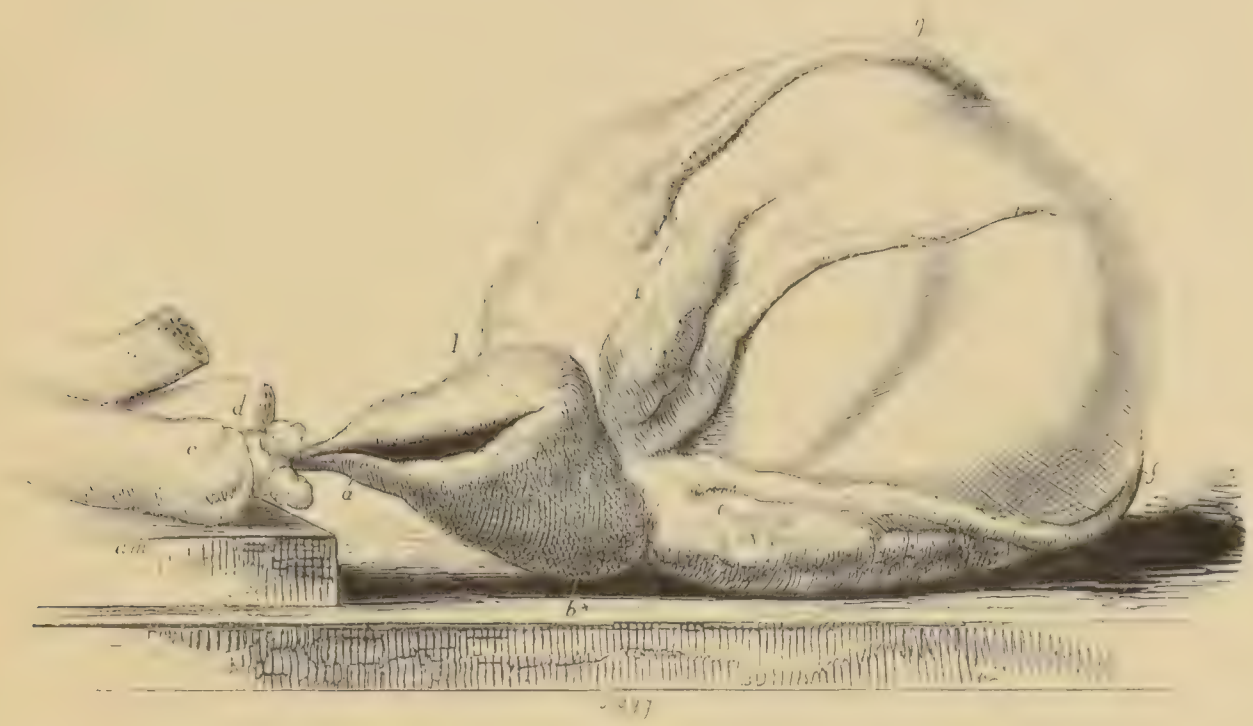
Of cutting down upon the urethra behind the stricture.—Some surgeons, in cases of complete retention of urine from stricture of the urethra, prefer making an incision in the perinæum, and opening the urethra where it is dilated behind the stricture, to the operation of puncturing the bladder.

For this purpose an incision is made in the course of the raphé of the perinæum, and is carried deeply down between the bulb and the rectum to the membranous part of the urethra. The urethra is exposed and opened where it is dilated, and the urine is evacuated through the wound, or by a gum catheter introduced by the incision into the bladder. In a very fat subject, or in one in whom the structures of the perinæum have become altered and condensed from previous disease, such as fistula in perinæo, abscesses, &c. this operation is by no means an easy one.

Puncture of the bladder above the pubis.—An incision, about two inches in length, is made through the integuments, immediately above the pubes, in the course of the linea alba. This incision is to be carried sufficiently deep between the edges of the recti and pyramidales muscles, to expose the anterior surface of the distended bladder where it is uncovered by the peritonæum. A trocar is then thrust obliquely downwards and backwards into the cavity of the bladder. After the trocar has been withdrawn, and the urine has been evacuated, the cannula should be fixed in the bladder until the inflammatory action following the operation has glued together the cells of the surrounding tissues, as the chief danger to be guarded against after the performance of this operation, is the escape of the urine into the subserous cellular tissue. After this time the cannula may be changed for a piece of gum catheter of appropriate length and thickness.

THE OPERATION OF LITHOTOMY.

Lithotomy still continues to remain, notwithstanding all the endeavours that have been made to improve it, one of the most difficult and dangerous of the operations of surgery.



This engraving represents the section of the left lobe of the prostate gland, which is made in the lateral operation of lithotomy. The parts have been dissected after having been separated from all their connexions. *a.* marks the incision, which, commencing in the membranous portion of the urethra, extends very near to the base or posterior edge of the left lobe of the prostate gland. *b.* The left lobe of the prostate gland. *b**. The right lobe of the gland. A slight projection in the posterior border of the gland marks the position and form of the third or middle lobe. *c.* The bulb of the urethra. Close behind are observed the two small granular masses named Cowper's glands. *d. d.* The crura of the penis. *e. e.* The vesiculæ seminales. *f. f.* The vasa deferentia. *g.* The ureter of the left side.

There are three principal methods of cutting into the bladder for the purpose of extracting a calculus from its interior: viz. first, by an incision through the perinæum; secondly, through the rectum; and thirdly, above the pubis. These various methods have been practised more or less extensively at different periods; though at the present day the two last-named are very seldom employed, and then only in consequence of some particular circumstances. It is thus that the operation of lithotomy above the pubis is usually reserved for those cases in which the calculus is of too large a size to admit of being safely extracted

through the perinæum, or in which the prostate gland is much enlarged. The employment of the recto-vesical method has been, in a great measure, confined to those surgeons who first introduced it.*

The lateral operation of lithotomy as performed with the knife. —The staff should be introduced into the bladder, and the stone felt previously to fixing the patient in the constrained position which is requisite for the safe performance of the operation. When the stone has been struck with the staff, the assistants may proceed to bind the patient's hands and feet together in the usual manner. The staff ought to be as large as the urethra will admit, and the groove as wide and deep as possible. The groove may be placed rather on the right side of the instrument, and should not extend quite to its extremity. The groove being placed upon the side of the staff enables the surgeon to cut into it more easily, and also to give that direction to his knife by which he divides the neck of the bladder and the prostate on the left side.*

The assistant now takes charge of the staff, grasping it firmly in his right hand, while with his left he raises up the scrotum from the perinæum. The handle of the staff should be held in a perpendicular direction, at right angles with the patient's body, at the same time that its curved part is drawn up closely underneath the arch of the pubes, in order to prevent its pressing too much downwards upon the rectum. The operator, before commencing his incisions, should feel for the prominence of the tuberosity of the ischium, and measure the distance between its inner edge and the anus.

The first incision. —This should be begun close to the left side of the raphé of the perinæum, and about an inch and a quarter in front of the anus: from this point it should be carried, in an oblique direction, downwards and outwards, so as

* As far as I know, M. Sanson, the surgeon of the hospital of La Pitié at Paris, has relinquished the recto-vesical method in favour of the bilateral operation. At all events, during a residence in Paris for a considerable period, I never saw him perform any other than the bilateral operation.

† Illustrations of the great operations of Surgery; by Sir Charles Bell, fol. 1821, page 117.

to pass midway between the inner edge of the tuberosity of the ischium and the left margin of the anus. In the adult, the length of this incision will be about three inches. While making the first incision, the operator fixes the integuments of the perinæum with the fingers of his left hand. The knife is struck at the first a full inch deep; and, as it is drawn downwards to the termination of the incision, it is gradually withdrawn from its deep position, in order to avoid wounding the rectum.*

The knife is now to be introduced a second time into the upper part of the wound; and the deep cellular substance, the transverse muscle, and a portion of the triangular ligament of the urethra and of the fibres of the levator ani are divided by repeated touches with the edge of the scalpel, until the membranous portion of the urethra is laid bare a little in front of the prostate gland. Feeling now the groove of the staff through the thin parietes of the urethra, the operator directs the point of his scalpel into it, guiding it along the back of the nail of the left index-finger. The opening of the membranous portion of the urethra should be sufficiently free to admit of the extremity of the finger-nail being easily placed into the groove of the staff.†

The point of the scalpel, or of the probe-pointed bistoury, if this instrument should be preferred, is now placed in the groove of the staff, and then carried slowly and steadily onwards into the bladder; dividing, as it passes along, the left lobe of the prostate gland in the direction of its longest diameter, which is obliquely downwards and outwards. The left index-finger depresses the rectum to the right side, so as to protect it from injury by the edge of the knife, while the membranous portion of the urethra is being divided to expose the groove of the staff, and, also, during the succeeding period, when the incision is made into the prostate gland, and neck of the bladder. As soon as the knife has entered the bladder, the urine escapes;

* Op. citat. p. 120.

† When the gorget or the bistouri caché is employed, this is the moment at which the knife is to be laid aside, and changed for one of these instruments, the beak of which is placed in the groove of the staff, guided along the finger-nail, and then carried onwards into the bladder.

the instrument is now to be withdrawn, and its place occupied by the fore-finger of the left hand, which serves to determine the size of the opening that has just been made, and also, if possible, the form and position of the calculus as it lies in the bladder. The staff should now be removed. If it is considered necessary to enlarge the wound, it may be done now, by cutting with a straight probe-pointed bistoury either in the direction of the original incision, or by dividing in a similar manner the opposite or right lobe of the gland : this last mode is the practice that is commonly adopted by Mr. Liston in his operations.

The forceps are to be introduced along the upper surface of the fore-finger, which still remains in the bladder, and serves as a conductor to these instruments. The blades of the forceps during their introduction should be kept closed, nor should they be expanded as soon as they have reached the interior of the bladder, but used at first as a searcher for the stone. As soon as the stone is felt, their blades may be opened upon it ; by so doing, the stone will in general be very readily seized.

It sometimes happens that the stone cannot be felt with the finger on account of the great depth of the perinæum, nor can it be readily laid hold of with the forceps. Should the stone, under these circumstances, be lying deeply behind the prostate gland in the bas-fond of the bladder, considerable assistance may sometimes be obtained by the introduction of the fingers of the left hand into the rectum, which will serve to raise it up and place it within the reach of the forceps.

When the stone has been seized by the forceps, the efforts at extraction should be made slowly and gradually, with an alternating movement laterally of the instrument, observing to follow the direction of the axis of the inferior outlet of the pelvis, which is obliquely downwards and backwards.

It is advisable, when any difficulty occurs to the extraction of the stone, to introduce the finger into the wound for the purpose of ascertaining whether the calculus has not been seized by the forceps by its longest diameter ; and, if such should be found to have been the case, to relax the hold which the blades of the forceps have upon it, while its position is altered for one that is more favourable for its removal.

The accidents which are most liable to occur in the performance of the operation are hæmorrhage and a wound of the rectum. The hæmorrhage may be furnished from the artery of the bulb,—from the trunk of the internal pudic, or from the smaller branches of it, the transversalis and superficialis perinæi. The artery of the bulb is avoided by not making the incisions, while exposing the membranous portion of the urethra, too high up towards the arch of the pubes. The trunk of the internal pudic ought not to be exposed to injury if the incisions are made in the proper direction, obliquely downwards and outwards; it is only by inclining the edge of the knife almost horizontally, and carrying it much too close to the margin of the bone, that this vessel is cut.

The rectum will not be wounded if care is taken to depress the bowel to the opposite side, with the finger of the left hand, while the membranous and prostatic portions of the urethra are being cut, and if the blade of the knife is sufficiently lateralised.

The structures that are divided in the first incisions of the lateral operation are, the skin, a portion of the superficial fascia where it covers the transverse muscle, and a part of the adipose tissue which fills up the ischio-rectal fossa. In the second incision, the transverse muscle and the small artery that runs along its posterior border, a portion of the triangular ligament, the membranous portion of the urethra, with the compressor urethræ muscle, are cut. A few of the most posterior of the fibres of the accelerator urinæ are sometimes divided. In the last incision, the left lobe of the prostate gland, with such of the fibres of the levator ani muscle as descend upon its side, together with the neck of the bladder, are divided.

It frequently occurs, after the operation of lithotomy, that the urine flows by the urethra on the second or third day, but soon afterwards it comes away only by the wound; this is owing to the temporary closure of the lips of the wound from the inflammatory swelling of the parts, which ensues after the operation.

When death follows the operation of lithotomy, and has not been caused by hæmorrhage, the principal post-mortem appearances will be found to be depending either upon peritonitis and inflammation of the bladder, or from diffuse inflammation of the loose cellular tissue which surrounds the base of the bladder and

is continuous with the subserous cellular tissue of the pelvis. This inflammation of the cellular tissue of the pelvis may be induced by the urine becoming extravasated into its cells, in consequence of not escaping sufficiently freely by the external wound; or it may arise independently of this cause, from the injury which it has sustained during the operation and the extraction of the stone.*

The bilateral operation.—This method, as practised at the present day, is but of very recent date, having been introduced by the late Baron Dupuytren.† The patient is placed in the same position as for the lateral operation of lithotomy. The staff having been introduced, it is given to an assistant, who holds it in such a position that its handle shall form a right angle with the patient's body; at the same time fixing it firmly against the inferior border of the pubic arch. The groove of the staff is placed upon its inferior surface. The operator then makes a curved incision across the perinæum, commencing between the tuberosity of the right ischium and the margin of the anus, but a little nearer to the former point, and terminating at the corresponding point upon the opposite side. The concavity of this incision must be directed towards the anus, and its centre should be situated upon the raphé of the perinæum, about six or eight lines in front of the anus. The skin, subcutaneous adipose tissue, superficial fascia, and anterior extremity of the external sphincter muscle having been divided, the index-finger of the left hand should be introduced into the centre of the wound, and the groove of the staff sought for, where it lies in the membranous portion of the urethra, between the bulb and the prostate gland. The urethra is to be opened here to the extent of three or four lines, when the extremity of the finger-nail should be inserted into the groove of the staff, to serve as a conductor for the beak of the lithotome. The operator now changes the scalpel for the lithotome, the point of which he places in the groove of the staff; taking care that the concavity of the instrument is directed upwards, and corresponds with the

* Vide Med. Chir. Trans. Lond. vol. viii. p. 206, for "Remarks on the best mode of making the incisions in the lateral operation of Lithotomy;" by Samuel Cooper, Esq. Surgeon to the Forces.

† The direction of the external incisions is similar to those of the operation described by Celsus.

curve of the staff. After assuring himself, by a slight movement backwards and forwards of the instrument, that the point is fairly lodged in the groove, he pushes it onwards into the bladder, lowering at the same time both the handle of the staff and the lithotome. As soon as the lithotome has been introduced into the bladder, its point is to be disengaged from the staff, which is now withdrawn. The lithotome is then turned round, so that its concave surface is directed inferiorly towards the rectum; after which it is to be drawn out (the blades being expanded by pressing on their handle) slowly and steadily, following the direction of the external incisions. As soon as the lithotome has been withdrawn, the fore-finger of the left hand is to be introduced by the wound into the bladder, to ascertain the situation and figure of the calculus, and to serve as a conductor to the forceps, which are to be carried, their blades being closed, along its upper surface. The staff is removed when the forefinger has been introduced into the bladder. The stone is then laid hold of, and extracted in the usual manner.

By this operation a much larger incision may be made in the prostate gland and neck of the bladder than in the lateral operation, without injury to the base of the gland, and the reflection of the pelvic fascia. It is alleged, also, by those who advocate the practice of this operation, that the risk of hæmorrhage is diminished, as well as of injury to the seminal ducts.*

Except in France, this operation has not been very extensively adopted.

The recto-vesical operation.—Two methods of performing this operation have been proposed and practised: in one, the membranous portion of the urethra, and the prostate gland, with a small portion of the anterior wall of the rectum, are divided; while, in the second, these structures, with a portion of the base of the bladder, are cut.

* It has been stated, that Dupuytren operated in this manner upon twenty-six cases in succession, in the Hôtel Dieu at Paris, without losing one; and that, out of seventy operations that he performed, only six terminated fatally. However this may be, MM. Sanson and Bégin, the editors of Dupuytren's posthumous work, give a table by which they show the mortality after the bilateral operation to have been as high as one in four and a half.—Vide Opération de la Piérre d'après une méthode nouvelle par le Baron Dupuytren; ouvrage terminé et publié par MM. Sanson et Bégin: folio, 1836, p. 12.

First mode.—A staff is introduced into the bladder, and is held by an assistant in the same manner as has been described in the account of the bilateral operation. The index-finger of the left hand is introduced into the rectum, and the staff felt as it lies in the membranous portion of the urethra in front of the prostate gland. The bistoury is now introduced into the bowel, its blade lying flat upon the finger; then, turning its edge upwards, an incision of about an inch and a half in length is made in the anterior wall of the rectum, and the external sphincter of the anus, as it is withdrawn. The bistoury is introduced a second time into the rectum, and the membranous portion of the urethra opened in front of the prostate gland; after which, the knife, its edge being now turned downwards, is pushed along the groove of the staff into the bladder, dividing as it enters the inferior portion of the prostate gland. The staff is now withdrawn, and the forceps introduced upon the finger, and the stone laid hold of and extracted.

Second mode.—This only differs from the preceding by the greater extent to which the incision that is made in the bladder is carried backwards. It is made to extend about one inch beyond the posterior edge of the prostate gland.

The advantages which have been urged in favour of the more general adoption of these operations are the simplicity of their execution, the freedom from all risk of hæmorrhage, and the ease with which very large calculi can be extracted from the bladder. But these advantages, important as they are, appear to be more than counterbalanced by the frequency of recto-vesical fistulæ, extensive suppurations within the pelvis, and injuries of the common seminal ducts. In one case, the recto-vesical cul-de-sac of the peritonæum was laid open.*

The operation of lithotomy above the pubis.—It will be recollected that, when the bladder is distended, the portion of its anterior surface which is uncovered by the peritonæum rises into the hypogastric region, where it is placed behind the recti muscles. In this situation it may be readily exposed by an incision through the inferior part of the linea alba. In performing this operation, the principal danger which requires

* Vide Nouveaux 'Eléments de Médecine Opératoire, par A. L. M. Velpeau; Paris, 1832, tom. iii. p. 793.

to be guarded against, is the wounding of the peritonæum as it is reflected from the summit of the bladder upon the posterior surface of the abdominal parietes.

Before the operation is commenced, the bladder should be moderately distended, either by the patient having retained his urine for some time previously, or, what is much better, by injecting a sufficient quantity of tepid water immediately before commencing the incisions. The patient is placed in the recumbent posture, with his shoulders gently elevated by some pillows laid underneath them ; while the legs are allowed to hang loosely over the lower edge of the table.

The operator, placing himself upon the right side of the patient, makes an incision of three or four inches in length upwards from the pubis, following the direction of the linea alba. When the skin and subjacent adipose tissue have been divided, the tendinous aponeuroses of the abdominal muscles (which by their intersection form the linea alba) are exposed, and must be cautiously divided to the same extent as the external incision ; a little cellular tissue now only remains to be cut, in order to expose the anterior surface of the bladder. It is during this part of the operation that great care is requisite lest, in carrying his knife too freely into the superior angle of the wound, the operator should open the sac of the peritonæum. When the bladder has been fairly exposed, it is to be opened either by plunging the knife into it at once, or by first transfixing it from within by a *sonde-à-dard*, which is introduced by the urethra for this purpose. The opening that is made in the coats of the bladder is to be enlarged by cutting towards the pubes ; after which, the finger is introduced into the bladder, with the double purpose of ascertaining the situation of the stone, and of preventing the collapse of the parietes of the bladder. Sometimes a blunt hook or crotchet is employed, instead of the finger, to sustain the edges of the opening in the bladder during the endeavours to seize and extract the stone. When the operation is concluded, a slip of linen or a cannula is placed between the edges of the wound, with the view of facilitating the exit of the urine.

The chief sources of danger after this operation, are the escape of the urine into the loose cellular tissue which surrounds the bladder, and the occurrence of inflammation and formation

of abscesses in the same structure. Several examples have been recorded in which hæmorrhage to a considerable amount has occurred after this operation; a circumstance which has been probably owing to some variety in the course and distribution of the vesical arteries.* The peritonæum has been frequently wounded in this operation, sometimes, fortunately, without being followed by any ill consequences.

* See Nouveaux 'Eléments de Médecine Opératoire, par M. Velpeau, tom. iii. p. 828.

ERRATA.

Page 18, line 18, *for* " pectiniforme " *read* " pecteniforme."
31, foot-note, *for* " strong hardness " *read* " stony hardness."

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